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FOURTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

January, 1873.

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G. V. FOX, of Lowell.

GEORGE DERBY, of Boston, *Secretary.*

CONTENTS.

ALPHABETICAL INDEX.

Commonwealth of Massachusetts.

State Board of Health, Boston, January 27, 1873.

Hon. George B. Loring, *President of the Senate of Massachusetts.*

Sir:—I have the honor to present to the legislature the Fourth Annual Report of the Massachusetts State Board of Health.

Very respectfully,

Your obedient servant,

GEORGE DERBY, M.D.,

Secretary of the State Board of Health.

GENERAL REPORT OF THE BOARD.

To the Honorable the Senate and House of Representatives of Massachusetts.

The State Board of Health herewith presents its Fourth Annual Report.

Small-Pox.

In our report of last year this subject, which has since become one of absorbing interest throughout the State, was considered at some length. In view of the epidemic then prevailing in Europe and also to some extent in Massachusetts, we thought it would be necessary not only to enforce the laws relating to vaccination, but to repeal the fifty-first section of the twenty-sixth chapter of the General Statutes, in order that cases of small-pox should be isolated. This absolute repeal was not accomplished, but the law was so modified as to give local boards of health much greater power for the removal of persons affected with the disease than they before possessed. Had the law remained as it was we cannot doubt that the destruction of life would have been even greater than has actually occurred.

We are now in the midst of an epidemic-influence of small-pox-poison more virulent than has been known for many generations. The evidence is abundant to show that both in Europe and America there is, for some reason entirely unknown, a readiness in the human body to receive both the virus of small-pox and the virus of the vaccine disease, such as no one now living has before seen.

There are records of such epidemics before the great discovery of Jenner, and they were truly terrible,—destroying from one-fifth to one-third of all who were seized, and this comprised the whole population except those who had been previously attacked, or had been inoculated with the small-pox virus.

The present epidemic is of such intensity that it is quite common for persons who have had small-pox in former years to now have it again. Such occurrences have been previously rare.

Vaccination, whether from the cow or from the human body "take" readily, and re-vaccinations prove abundantly the extraordinary susceptibility to the vaccine disease now prevailing, and *never before existing*.

In view of these facts, with which physicians and intelligent persons of whatever calling are now familiar, let us thank God for Jenner's great discovery, without which our homes would be desolated, and our peace and happiness destroyed. The imagination can hardly picture the horror which would to-day pervade Massachusetts were the present epidemic unchecked by vaccination.

We regard the law of the State authorizing town boards of health to remove persons affected with small-pox from their homes *only on certain conditions*, as unfortunate in its operation, and we think that it would have been better to repeal the 51st section, 26th chapter General Statutes without reservation, leaving it at the option of the local authorities to enforce the removal to a hospital, or to provide for the sick at their own homes, as might seem safest and best in each individual case.

From our correspondent at Worcester we learn the following facts in support of the opinion above expressed. "One man with modified small-pox was ordered to keep his room; but instead of doing so went to the college regatta. One of our most prominent business men would not stay in the house when he had a large crop of small-pox eruption, and insisted on going wherever he chose. A dentist having modified small-pox was told to keep his room and see no one; but instead of doing so, filled teeth in his office."

The special report on small-pox published in our third annual report, recommended that the law concerning vaccination be so modified as to require the primary vaccination of children within six months of birth. Three months would be still better. Under present circumstances a new-born child should be vaccinated without a week's delay.

The advice which has thus far been given by our Board with reference to small-pox has been as follows:

On the 10th of April, 1871, a circular was sent to the authorities of every city and town, warning them of the impending danger from small-pox, and urging the importance of immediate vaccination before the epidemic should get a footing within their boundaries.

Inquiries were then made from our medical correspondents all over the State, concerning the protection of the people by vaccination. Their replies, with other information on the general subject, were made the basis of a report on small-pox by our Secretary, presented to the legislature in January, 1872.

The Board at that time recommended the repeal of the fifty-first section of the twenty-sixth chapter General Statutes.

We would again urge upon the boards of health of cities and towns,—

1. To see that every person within their jurisdiction has the protection of recent vaccination.

2. To use all the powers which are permitted under General Statutes, *to isolate* every case of small-pox or varioloid which may occur.

3. To provide for the destruction of small-pox virus, under medical advice, in all infected clothing and premises.

Having done these things their whole duty as regards small-pox will have been performed.

The following order was adopted by the House of Representatives January 21st, 1873:—

Ordered, That the State Board of Health be requested to report to this House the number of towns and cities in the Commonwealth in which cases of small-pox have appeared during the years 1872 and 1873, the number of cases in each, the supposed cause of its appearance, and the whole number of cases at present in the Commonwealth.

In accordance with these instructions we have sent letters of inquiry to every city and town.

The replies will be communicated to the legislature as soon as received.

Miller's River Commission.

The Joint Commission, consisting of the Board of Harbor Commissioners of the Commonwealth, and the State Board

of Health, created by chapter 353 of the Acts of the year 1872, entitled, "An Act for the abatement of a nuisance in the Lower Basin of Miller's River, and for the preservation of health in the cities of Cambridge and Somerville," and charged by said Act with the duty of devising a plan of draining and abating a nuisance in a district in said Act described, bordering upon Miller's River in Cambridge and Somerville, and of reporting the same to the mayors and aldermen of said cities, entered upon their duties at once. The parties interested were heard, and the locality in question was visited and carefully examined.

The Commission then appointed an engineer to make original surveys of the territory, to ascertain the extent of water-shed, the source of the nuisance existing, and to report such plans as would meet the requirements of the Act. This duty was assigned to Mr. Phinehas Ball of Worcester, who accomplished his difficult work in a manner to not only satisfy the members of the Commission, but to win their hearty and unanimous approbation.

The recommendations of Mr. Ball were adopted, and a report based upon the plan he proposed was made to the mayors of the cities of Cambridge and Somerville on the 7th of December, 1872. It is understood that this report will appear in the Annual Report of the Harbor Commissioners, and it is therefore unnecessary to present it in this connection.

The following were the conclusions of the Miller's River Commission :—

"*First.* That the city of Cambridge complete its system of sewerage, so that such portion of its territory as is now drained into Miller's River be drained into sewers already made or projected, having their outlets into Charles River.

"*Second.* That the city of Somerville construct a main sewer, from Milk Street through Prospect, Washington and Cambridge Streets, into Tufts' Dock in Charlestown, on Mystic River, and connect with this main sewer, lateral sewers, in such a manner that whatever now drains into the Miller's River basins, will drain by this main sewer into the Mystic River, and that the city of Somerville obtain the requisite legislation to carry this main sewer through the territory of the city of Charlestown.

"*Third.* That the cities of Cambridge and Somerville fill up with clean gravel, to the grade authorized by law, all the channel, flats, and basins of Miller's River, lying east of Prospect Street in Somerville, and south-west of the Boston and Lowell Railroad; reserving at first from such filling, through the middle of said channel and basins to the outlet under the Boston and Lowell Railroad, a space not less than fifty feet in width, where such a width is possible, until the drainage of the territory of Cambridge and Somerville, now leading into these basins, has been diverted from them into Charles and Mystic Rivers, as herein before provided, and then in the months from November to April inclusive, finally removing from this reserved space the mud which has there accumulated in the process of filling the adjoining areas.

"*Fourth.* It will then remain to enforce those sanitary principles which the Commonwealth has already adopted with reference to industries of the class peculiar to this neighborhood.

"The Commission has adopted no temporary measures in regard to this nuisance, because it was conceded by the representatives of both cities, and of all other parties appearing before the Commission, that none could be devised that would give any substantial relief, and such was the unanimous opinion of the Commission."

It is hoped that this plan of abating a nuisance, which has so long affected the health, comfort and convenience of the occupants of the crowded territory around the Miller's River Basin, will be speedily carried into effect.

Sewerage of the Metropolitan District.

In connection with the investigation concerning Miller's River, and the practicable plan of sewerage reported by the Commission, we would respectfully invite the attention of the legislature to the need of some comprehensive and harmonious system for the drainage of the whole Metropolitan District. Cambridge and Somerville, in the difficulties they have encountered by the joint use of an insufficient outlet for their sewerage, may fairly represent other cities and towns in the immediate vicinity of Boston, whose trouble will come very soon from similar causes.

A competent engineer, surveying the whole territory without regard to the limitation of arbitrary lines representing the limit of jurisdiction of a single municipality, has, as we believe, solved a problem which might have vexed Cambridge

and Somerville for a generation. At the recent extra session of the legislature, an Act was passed providing for a commission of engineers to report plans for the sewerage and water supply of the Metropolitan District, but it failed from the non-concurrence of the city of Boston. It is hoped that some similar plan, free from the very reasonable objections which were made to the Act rejected by Boston, may be soon undertaken. It seems to us of great importance in the interest of public health that some comprehensive system should be adopted.

Revision and Codification of Health Laws.

We wish to call the attention of the legislature to the expediency of revising and simplifying the laws relating to public health. These laws are intended to give the boards of health of cities and towns authority to control every form of nuisance, to keep in check all contagious or infectious diseases, and to secure to every citizen the enjoyment of all those natural agencies whose purity can only be obtained by public authority.

To accomplish these objects the statutes have been frequently amended, and additions have been made. Some of these amendments and additions are very obscure in their meaning.

The State Board of Health is often applied to by the boards of health of cities and towns to know what is the exact measure of power they possess under certain circumstances, and for aid in the interpretation of certain statutes. In reply to such applications every aid is given which it is possible for our Board to supply. But we would respectfully suggest to the legislature that such interpretation of the meaning of the health laws is often difficult by reason of their complexity, and that it would greatly conduce to the efficiency of the local boards, and to the maintenance of public health, if these laws could be reduced to a form which any intelligent citizen could perfectly comprehend.

The Law concerning Slaughter-houses and Noxious and Offensive Trades.

Numerous complaints have been received by the Board during the past year concerning establishments liable to be

closed by the operation of this law. In every case, however, with the exception of one very recently brought to our notice, the party complained of, when visited by our Secretary, has expressed a willingness to do everything which the Board and the complainants thought necessary. Such concessions have satisfied all parties, and the complaints have been withdrawn. This disposition is in striking contrast with the experience of the Board in 1871, when "hearings" were necessary in nineteen cases, and many of them were very protracted, through the testimony of a great number of witnesses, and the elaborate arguments of counsel on both sides. It is very apparent that the readiness of parties maintaining nuisances of a character which makes them amenable to the State Board of Health, to do all which is needful to protect the health, comfort and convenience of their neighbors, is the direct result of the orders issued by our Board in the summer of 1871.

The Boards of Health of Cities and Towns in Massachusetts.

Very great powers to secure the public health and safety are given by the General Statutes to the local boards of health. By chapter 26, section 5, they are empowered to make such regulations *as they judge necessary*, and a penalty not exceeding one hundred dollars is affixed to the violation of any rules thus established. It only remains for the people to fill these offices with wise, discreet and fearless men.

If we could reach every citizen, we would counsel him to see to it that such men are selected as a special board to look after the interests of public health in every town of Massachusetts, at the coming March meetings. And we would say, moreover, that one member of every such board should be a physician. In our correspondence and intercourse with the cities and towns throughout the State, nothing is more evident than the need by the members of these boards of such special knowledge of the causes of disease as it is the business of a physician to be acquainted with.

The time has gone by when any physician could ignore the causes of disease, and prescribe only for the relief of present ailments. Medical books and periodicals are now full of interesting inquiries, whose object is to *prevent the occurrence of disease;* and this literature reflects the thought of the medical

world. Every town can have the benefit of this knowledge by availing itself of the services of an enlightened physician on its board of health. He will recognize the special dangers, unseen by others, because it is a part of his daily business to find them, and his faculties are quickened by use. He goes everywhere, sees the whole territory more frequently than any one, knows the character of the soil, of the water, and estimates the power for evil which the ignorance or slovenliness or cupidity of his townspeople suffer to exist about their dwellings in the form of putrescent materials. By his personal influence and advice the laws of health may become available for the use of every family. Nuisances may be reformed, air and water may be kept pure and wholesome, and an unceasing vigilance may be exercised to preserve, for the common good, the great essentials of health so that no one's bodily comfort shall be disturbed by such neglect as can be remedied by private advice or public authority. Much needless vexation may be also avoided by the employment of a medical man on a board of health, since he, better than any one, can discriminate between what is and what is not harmful to the public. There are now many towns in Massachusetts employing a physician on their board of health, and in every such instance which has come to our knowledge the great benefit has been apparent.

Butchers' Slaughtering and Melting Association.

Our report concerning the operations of this Association during the year, is one which we have great pleasure in making.

The abattoir, for whose construction we have labored ever since the formation of our Board in 1869, is nearly completed. That it is not yet in operation will not surprise those who may visit the establishment and see the magnitude of the undertaking.

A letter from the president of the association to our Board will be found to give the details of the work. That it will prove a sanitary success we feel well assured, and we also hope that it may be remunerative to its enterprising proprietors. The plans and all details of construction have

been approved as the law requires, and have been under the constant supervision of a committee of our Board.

We desire to call the attention of the legislature to the fact that no provision has yet been made for the inspection of animals and of meat. That such inspection is absolutely necessary to complete the benefits which the public will receive from the abattoir needs no argument.

Whoever buys meat from this slaughter-house must in some way be assured that the animal was in health when killed.

The fresh meat will be consumed for the most part within twenty miles of Boston, but the salted meats will be distributed far and wide.

We respectfully ask the legislature to provide for the appointment of an inspector of animals and of meat, at the abattoir of the "Butchers' Slaughtering and Melting Association" at Brighton, with an adequate salary, to be paid by the State, and that this inspector be under the control of this Board, since we are by the law made responsible for the safe and proper management of the establishment.

Special investigations have been made during the year, concerning many subjects having a direct influence on the maintenance of public health, and the results are printed in the accompanying documents. They are as follows:

Sewage and Sewerage; The Pollution of Streams; The Water-Supply of Towns.

A report in accordance with an order of the legislature. By WILLIAM RIPLEY NICHOLS and the SECRETARY OF THE BOARD.

The following order was adopted by the last legislature and transmitted to our Board on the tenth of April, 1872:—

"*Ordered.* That the board of health be requested to consider the general subject of the disposition of the sewage of towns and cities, having in view:

"*First.* Its utilization as a fertilizer.

"*Second.* The sanitary effects of draining the same into the waters of the Commonwealth.

"*Third.* The increasing joint use of water-courses for sewers, and as sources of supply for domestic use by the people of the Commonwealth.

"And that the said Board be requested to report to the next legislature their views, with such information as they can obtain upon the subject from our own or other lands."

The reply to the above order of the legislature is presented in a report prepared by Prof. William Ripley Nichols of the Institute of Technology and by the Secretary of our Board.

Prof. Nichols visited England during the summer, and gives the results of his observations.

The interest in these subjects in England at the present time is very great. There are also much partisanship and heated controversy in that country which tend to obscure the essential facts. Much capital is embarked in projects for utilizing sewage, and many English publications show its influence in unduly exalting their own special plans. Owners of patent rights magnify their value.

We in Massachusetts are so far removed from the strife that we should be the better able to form an intelligent judgment concerning some of these important questions.

The Board commend this report to the attention of legislators, officers of city and town government, and to all citizens.

The question of the utilization of sewage remains still unsettled. It is attended with great difficulties in all countries, but especially in our own, owing to the high price of labor, and to the dilution of sewage both from our profuse consumption of water, and the great annual rainfall, which is nearly double the annual rainfall of England.

Our reporters find little reason to expect good results from any purely chemical processes thus far proposed. Irrigation with sewage gives better promise. It would have to deal with frozen ground in Massachusetts for a portion of every year, but this trouble would not be met with in our Middle and Southern and a great part of our Western States.

We wish to call the attention of the legislature to the strong reasons given in this report, for the careful protection of our lakes and great ponds from defilement, since we believe the present and future health of the crowded cities and towns of Massachusetts, to be closely dependent upon the preservation of these reservoirs of pure water for domestic use.

Additional analysis of evidence as to the use and abuse of Intoxicating Liquors.

Beershops and Prohibitory Laws.

By Hon. P. Emory Aldrich, member of the Board.

We have much pleasure in presenting this paper which relates to evidence presented in:

1. Three printed documents sent to us by officials of the United States government in England.

2. A very voluminous and carefully prepared statement in manuscript from a gentleman holding an office under the Swedish government, giving an account of the use of intoxicating drinks in that country from the earliest times.*

3. A large number of letters from officials and private individuals, in this and other States, which have been very recently sent to our Board by a committee of the State Temperance Alliance of Massachusetts.

We present this paper by Mr. Aldrich, as we last year presented the paper by Dr. Bowditch, regarding both of them as valuable contributions to the discussion of the general subject of the use and abuse of intoxicating drinks, but without expressing, as a Board, any opinion concerning the inferences made by either writer.

On the character of substances used for flavoring articles of Food and Drink.

By Henry K. Oliver, M. D.

The Board recommend the careful perusal of this paper by every house-keeper and every parent. By it we learn that many articles, in common use as delicacies, are flavored with deleterious and even poisonous substances. We learn that the oil of almonds, used by confectioners, contains prussic acid, and that the almond extract, so much employed in domestic cookery, also contains this poison in a large amount; that almost all the candies, and many of the soda-syrups, bearing the names of the easily perishable fruits, as the

* Mr. Gyllenskiöld, our correspondent above referred to, sent also very elaborate statistical tables showing the enormous annual production of distilled spirits in Sweden. These tables were referred to the Chief of the Bureau of Statistics, Treasury Department, Washington. Their early publication by the Bureau in one of their monthly statements was promised, but they have not yet appeared.

strawberry, raspberry, banana, &c., &c., *have no trace of the fruit about them*, but are flavored by "fruit essences," which are deleterious etherial extracts, made in the chemical laboratory; that many of the fruit jellies in the market are made from apples, and flavored by the same artificial essences, to resemble the various fruits from which they are supposed to be made; that cheap wines, and other alcoholic liquors, are sometimes sophisticated by these essences and by other flavoring substances; and, finally, that tartaric acid is openly sold to be used as a substitute for fruit in pastry.

Drainage for Health.

By Hon. Henry F. French.

This is an eminently practical paper which will be of value in every country town.

The writer, Judge French, is already well known in connection with the general subject of which he treats. Excellent advice is given concerning the necessity of keeping wells free from surface and sewer drainage, and methods are proposed to gain these important ends. The plans are simple, efficient, inexpensive and easily executed by any intelligent man, aided by a very little mechanical skill.

Infant Mortality.

By Edward Jarvis, M. D.

This a most important subject. Dr. Jarvis deals with it with his wonted ability. The influence of food taken by the mother and her child, upon the latter's health and life is treated of. And in addition, the reader will find statements in reference to exposure to cold, and influences produced by hard labor, poverty, ignorance of sanitary laws, of fashion, and of civilization, &c., upon the mortality of infants.

The Food of the People.

By the Secretary of the Board.

This paper, founded on an extensive correspondence throughout the State, aims to let the people know the extent of their deviation from true methods in the providing and in the cooking of food. Significant reports come from various quarters of the State, in regard to evils, and of actual deaths,

resulting from either neglect or ignorance concerning this matter of food. Attention is drawn to the differences between the food of the mechanic and of the farmer, and of the gross imperfections of both. Dyspepsia seems very prevalent in some communities, owing to bad food and the inordinate use of tea and coffee. Wholesome bread is rare; its making is almost one of the lost arts, in some towns.

The results of "bolting" food, so common not only among railway travellers, but with large numbers of our people, are alluded to. One correspondent suggests the thought that, for the future health of our people, the art of cookery should be publicly taught: and another proposes that, by coöperative measures, comfortable dining-rooms for sewing-girls employed in cities should be established, where good substantial food could be got at moderate prices. Finally, one correspondent, a physician, writes that the people are sinning through ignorance; and that he is sure, from his own experience in the town where he then lived, much change had been introduced into the culinary department of many families by his persistent instructions given during the rounds of daily practice. The example of this young man, now, unhappily for his people, dead, is respectfully submitted to all physicians, in the full confidence that, if every one would in his own sphere, endeavor so to influence his neighbors, incalculable benefit would result.

The Adulteration of Milk.

A Report by Arthur H. Nichols, M.D., Assisted by Prof. James F. Babcock.

In this paper will be found the means of testing milk, and facts seeming to prove the almost universal sophistication of milk as delivered in Boston.

The writer calls attention to the present imperfections of the law with reference to this subject, which must be regarded by every one as of great importance.

Analysis of a Correspondence on some of the Causes of Consumption.

By the Chairman of the Board.

This paper is based on the analysis of a correspondence held with two hundred and ten physicians, resident in this

State and elsewhere. The letters are in answer to a circular issued by the Board. They come from intelligent men, all of them in constant practice, and their replies represent, in as far as this number can represent it, medical opinion on the various questions proposed. As such, the Board presents the analysis and extracts from the letters as a contribution to the discussion of the causes of this dreadful scourge of our State, —pulmonary consumption. At a future time the Board hopes for a continuation of the same subject; than which nothing can be more important, since consumption destroys in Massachusetts, about one-fifth of all who die.

Adulterations and Impurities of Food.

By H. B. Hill, Harvard University.

This investigation is in pursuance of a general plan which was commenced in 1871, and which we hope to continue.

In our third report Mr. Hill gave the results of his examinations of canned fruits, vinegar and coffee.

The present report deals with confectionery and pickles. By it we learn that lead, mercury, arsenic and copper are not infrequently found in the coloring matter of confectionery, and especially of sugar toys; and that the bright green color of pickles is an indication of copper.

The perusal of Mr. Hill's report is commended to mothers and house-keepers.

House Accommodation of the Poor in our most Populous Cities.

By F. W. Draper, M.D.

This is a most significant report by Dr. F. W. Draper, from personal inspection of the homes of the lowest poor in Boston, Fall River, Lawrence, Lowell, Salem, Lynn, Springfield and Worcester. It proves conclusively that the municipal authorities of every one of these places named have been neglectful in regard to carrying out the wishes of the legislature, as known by laws passed at various times. Lowell, owing to the recent epidemic, has been summoned to use those laws, and has acted upon them most efficiently in crushing out the small-pox. But evidences are now arising which show that the same laxity in regard to hygienic

measures which existed before the late panic, will ere long again prevail. In each and all of these cities, rookeries are to be found which are a disgrace to our civilization. It is interesting to observe, however, that in some places,—for example, in Lowell, Lawrence and Salem, where great corporations have erected large tenement-houses for their operatives, and have had them constructed and maintained upon hygienic principles,—the happiest results have followed. Due notice is taken by the writer, of those vile owners and lessees of tenements who prey upon the community by exacting exorbitant rents for places unfit for human occupancy.

The whole paper deserves a most careful study, not only by the municipal anthorities of the cities reported upon, but by the selectmen, boards of health and inhabitants of every town. For it is evident that as similar causes exist in every large town, so similar evils are likely to be found throughout the State; and these evils, as far as possible, should be prevented by wise public law and by private effort. We have, in fact, among us, and rife, all the elements of the lowest barbarism, in which men and animals lie down together in filthy abodes. And, although this barbarism at present clings to a small portion of the community, it will be found to taint with its impurities a large area occupied by a better and more civilized class. It at times promotes a moral and physical pestilence and death.

Health of Towns.

This annual statement from our correspondents relates chiefly, in the present year, to the subjects of sewerage and water-supply in the largest towns.

It is our hope that the need of these most important means of improving the health of our rapidly growing cities and towns may be brought to the notice of the people of Massachusetts more prominently through the information contained in these letters, as well as by other papers in the present volume.

It will be seen that the mortality of Boston is unprecedented. Exclusive of deaths from small-pox, the mortality of 1872 exceeds that of 1871 twenty-five per cent. Includ-

ing small-pox the increase is thirty-seven per cent. Such results seem fully to justify all which has been said in previous reports of our Board concerning the culpable neglect of public health by the city authorities of Boston.

Public opinion has at last been thoroughly aroused, and has compelled the aldermen to relinquish a large share of the power which they could not wisely exercise, and has placed it in the hands of an independent board, from whom we have reason to expect the most salutary reforms. In all their efforts to reduce the mortality of Boston they will have the cordial coöperation of our Board.

It will be seen that *trichina disease* has occurred in Framingham. This is another warning against eating pork which is not *thoroughly cooked.*

The expenses of the Board have been a little more than usual, owing to the chemical investigations required to complete the report on sewage in accordance with an order of the legislature. It is hoped that the same appropriation for the Board may be made in 1873 as in the past year.

We desire to express our thanks to the registrars and city clerks of the most populous places in Massachusetts, for their politeness in furnishing the information which has enabled us to make a report of mortality in the "Boston Journal" every Wednesday morning.

All of which is respectfully submitted.

HENRY I. BOWDITCH,
WARREN SAWYER,
RICHARD FROTHINGHAM,
R. T. DAVIS,
GEORGE DERBY,
P. EMORY ALDRICH,
G. V. FOX,

Members of the State Board of Health of Massachusetts.

EXPENSES OF STATE BOARD OF HEALTH, 1872.

Postage and stationery,		$450 92
Soldier Messengers,		78 93
Travelling expenses of Secretary,		118 44
Expresses,		67 93
Copying and indexing,		74 52
Carriages,		58 50
Printing,		37 85
Personal expenses of Members of the Board,		78 59
Chemical analyses,		662 12
H. F. Walling, for Report on Lakes and Ponds,		325 00
Paid for special investigations,—to	Wm. Ripley Nichols,	
	H. K. Oliver, Jr.,	
	H. F. French,	
	F. W. Draper,	1,894 35
	H. B. Hill,	
	Phinehas Ball,	
	A. H. Nichols,	
	Edward Jarvis,	
Miscellaneous expenses,		31 71
		$3,878 86

Sewerage; Sewage; The Pollution of Streams; The Water-Supply of Towns.

A REPORT

TO THE

State Board of Health of Massachusetts.

By WM. RIPLEY NICHOLS,

Professor of General Chemistry in the Massachusetts Institute of Technology,

AND

GEORGE DERBY, M.D.,

Secretary of the State Board of Health.

Sewerage; Sewage; The Pollution of Streams; The Water-Supply of Towns.

On the 6th of April, 1872, the State Board of Health was instructed by an order of the legislature, which will be found in the General Report on the tenth page of this volume, to collect information concerning sewage and the possibility of utilizing it, the pollution of streams and the water-supply of towns, and to make report at the next session.

These subjects concern every inhabitant of Massachusetts; they reach to the very foundations of national health and prosperity; and they are now most earnestly discussed in all civilized communities throughout the world.

They press with great force upon the people of this State at the present time. Our centres of manufacturing and commercial industry are growing with unexampled rapidity. Population is leaving the rural districts and crowding into the towns. Villages are transformed into compactly built cities in a single generation.

Some of the brooks which were but recently pure and undefiled are now polluted so that neither man nor beast will freely drink of them; and this change is insidiously taking place from year to year. The great importance of the subject was pointed out by the State Board of Health in their second annual report (1871). An examination was then made of the waters of Mystic Pond and of its sources both of supply and of defilement, and the results obtained were, in so far as that important source of drinking-water is concerned, a direct reply to the recent order of the legislature.

The utilization or "*beworthing*" of waste material of every sort is of equal interest to the political economist and to the sanitarian. To the one it is a direct saving of money; to the other a saving of health and of life, both of which have a true

money value. Fortunately these two great interests, as we believe, do really coincide.

They may sometimes appear to conflict, and with our present imperfect knowledge of the best methods of utilization they may even stand, for the time, in direct opposition to each other, but a way will be eventually found to bring them into harmonious relations. The waste of our Brighton slaughter-houses which polluted the air, at the same time increased the cost of furnishing meat for the markets. The utilization of this foul stuff is now seen to lead not only to health and comfort, but to profit also. And so it will eventually be with every form of waste organic material which so abounds where population is dense and industry is active.

We must never despair of success in the search for the means of converting our waste into useful and harmless products, however great may be the difficulties in the way.

Obstacles which now seem well-nigh insuperable may be expected to become less formidable and at last to disappear before the advance of science and of skill. It is no exaggeration to say that this problem of the conversion of the excremental waste of towns and people and the refuse of factories, into useful materials, is now engaging as much of the attention of intelligent minds throughout the world as any social question. The English press is burdened with publications on this general subject. Chemists, farmers, political economists, engineers, physicians and amateur sanitarians are all at work upon it. Towns and cities are making costly experiments to test the worth of all the various plans proposed. Stock companies are formed, whose business is first to make money for themselves at any rate, and secondly to benefit the rest of the world by their ventures. From all this excitement, which will eventually extend itself to our crowded districts, we ought to derive much useful information, and should be able, removed as we are from the heat of the controversy, to see things as they really are, and to estimate the various plans at their value. But while it is of great importance that we duly note whatever may be seen or known in foreign countries, it is still more essential that all facts bearing on these questions among ourselves should be carefully observed.

Our climate, soil, customs and social arrangements are our own, and unlike those of other countries. They require to be regarded by themselves.

It has been our endeavor during the past summer and autumn to collect as much information as possible concerning these points from all parts of the State, that thus a fair beginning might be made in the comprehension of the subject.

Let us first explain what is meant by the words "sewer," "sewerage" and "sewage," which will be constantly used. The two last are often confounded, but they signify quite different things. A *sewer* is an underground passage for the conveyance of water, human excrement, and fluid or half-fluid refuse emptied into it by the smaller drains from houses, factories and streets.

Sewerage is a system of sewers or subterranean conduits, and the word refers only to these works or constructions, while *sewage* is the material which is or may be conveyed in sewers.

Public health requires that the foul fluids, half-solids and solids resulting from human excretion, from the waste of food, from washing, and from the refuse of various manufactures should be either speedily removed from among the living, or that the character of these materials should be so changed that they will not undergo decay.

The urgent and instinctive need of absolute removal is felt by every one with regard to human excrement. We must be rid of it. There can be no safety otherwise. In the country, in isolated dwellings with plenty of ground about them, this purpose is accomplished by detached buildings from which the material may be readily removed and used as manure.

In compactly built towns and cities this method poisons the air, and if wells are used it renders themdangerous to all who drink from them, however clear, sparkling and inodorous the water may happen to be.

The Dry-earth System.

This method of disposing of human excrement has been a subject of general discussion of late, and its advantages and disadvantages should be fairly presented.

Abundant experience has shown that earth (not gravel or sand), when carefully dried so that it has lost all coherence or stickiness and has become a powder, possesses the power of absorbing and reducing to an inodorous form the excretions of the human body, provided it be immediately applied to them, and in amounts sufficient to cover them and to remove all fluidity of the resulting mixture.

The mass may be removed at convenient times and seasons and used immediately as a fertilizer for land, or it may be dried and used many times without giving off any offensive odor.

The dry ash of hard coal or anthracite may be also used instead of earth.

These are very important facts for everybody to know. Whether the action of the dry earth or ash be chemical or mechanical need not concern us; the effect is as we have stated.

It will be seen that the conditions under which the dry-earth plan can be used are exceedingly limited. In the first place the earth must be dried, and must be kept dry at all times for immediate use. This involves labor, and intelligent care and foresight. If the ash of anthracite coal be used the value of the product as a fertilizer is diminished.

In the second place, the artificial drying of either earth or coal ash for use a *second* time in private houses would be expensive, inconsistent with our social arrangements, and almost impracticable.

In the third place, no slops or sink-wash or any other fluids can be added without causing foul odors and making a nuisance, and from this it is seen that drains and sewers are still absolutely required, and that the dry-earth system cannot supplant them, but only relieve them of certain offensive contents.

In the fourth place, no one has yet shown that the foul odor is any measure of the danger from the retention of human excreta about our dwellings. It may be that while deprived of offensive smell these materials may yet, under certain circumstances, convey disease.

The difficulties which must attend the general use of the dry-earth plan in densely populated cities and towns seem to

us insuperable. If it is intended to absorb both the solid and fluid excretions of the human body (and the latter contain far more fertilizing material than the former), four or five pounds of dry earth must be supplied daily for each individual. Thus in a city of 100,000 people, 250 tons must be brought in every day from the surrounding country, and a somewhat larger amount carried out. And this must be divided among some 10,000 different houses, each of which must be carefully provided for.

With laborers' wages at $2 a day it will be seen that financially such operations are absolutely impracticable. The difficulty of enforcing care and cleanliness among the improvident classes makes such plans equally visionary in a sanitary point of view.

But the case is altogether different with country houses * having land about them from which the earth may be taken and to which it may be readily and profitably returned.

As regards houses in the country, there are also other and very weighty reasons for preferring the dry-earth plan. The wells may be protected from the fouling which they now so often get from human excrement, although their danger from drain and sink water is not in this way avoided.

The stench of the privy may be completely abolished. There can be no injury from frost, which is a much dreaded foe in our climate in all country houses furnished with water-closets.

In prisons and other large establishments where labor is abundant and cheap, the earth system may be applicable; possibly, also, in boarding-schools.

There can be no doubt that in country hotels and boarding-houses which are crowded with visitors in summer, the proper use of dry earth would remove a frequent source of discomfort and of danger. But here, as everywhere in New England, labor is dear. Guests are numerous and servants few. We have known several country boarding-houses where this method was professedly tried, but the earth was left exposed to wet, or was not systematically applied, and the result was a failure.

* See 2d Report of this Board (1871), pp. 235, 236.

In short, it may be said that the earth-plan is good and effectual, provided the conditions above stated are fulfilled, but these conditions are many and strict. It is a novelty, possessing claims upon the attention of every sanitarian, but like many other new things has perhaps been overrated. If it were in general use we could by no means do without drains and sewers, for the earth-plan cannot dispose of fluids except in very limited amounts.

Let us suppose that the dry-earth plan had been the only means of disposing of human excreta, as it is said to be in China, and that it was proposed as a new discovery that water should now be used instead. A reservoir being formed above, the water by a simple contrivance is turned on, and washes away through underground pipes all offensive things. Would it not be hailed as a blessing? Would not everybody rejoice in being rid of the continual annoyance of fetching and carrying, and in substituting therefor the force of gravity which is always ready to help us?

The disadvantages of the water-system are familiar to us from long use. The disadvantages of the earth-system, as applied to large communities are not so plainly seen because it has never been tried, while the advantages are, perhaps, overestimated through the novelty and (apparent) simplicity of the plan.

The Water-Carriage System.

The second systematic method of disposing of human excreta is by the underground drains and sewers which all compactly built towns are obliged to have in order to get rid of the surface-water falling as rain, and the liquid slops from washing and cooking, and also to a greater or less extent to relieve the soil of the superfluous water which it holds.

Drains and sewers have been in use for thousands of years, but it is only within the present century that they have been made carriers of excrement. Their use, however, for this purpose has increased of late in all civilized countries; and it seems probable that this will soon be the universal method employed in cities and crowded towns. We have already referred to some of its manifest advantages. The saving of labor is one which must specially commend it to all Ameri-

can communities. It is almost automatic in its operation. It sweeps away from our sight the most offensive things. It is capable of entirely relieving a city or town of the presence of such foul collections of putridity as are always disclosed in an ordinary privy vault. When a great fire destroys the houses and uncovers the earth in an old town, we can see how numerous and how vile are these places. Would not everybody desire to have such filth removed and the site of the town thoroughly aired and purified before the houses were rebuilt? By the water-closet system we are really enabled to keep the ground on which we live from being polluted by human excrement.

The water-closet system is, however, attended with special dangers which we should seek to avoid.

The Ventilation of House-drains.

By the use of water-closets and their attendant conveniences of fixed wash-bowls, bathing-tubs and sinks, the interiors of city houses are brought into close communication with the sewers. Whatever gases are contained in these underground passages seek not only to diffuse themselves under the law of nature with regard to gaseous bodies, but are also frequently subjected to severe pressure.

These gases are dangerous to health. What the specially noxious element in them is, no one can define. It is evidently neither carbonic acid, nor sulphuretted hydrogen, nor any other of the gases with which chemists are familiar in the laboratory. There is something beyond all this, coming from the decay of organized substances in a closed, pent-up position, without the free access of light and air, which at times gives rise to the most virulent poison, and to the most destructive forms of disease.

The sensible properties of sewer-air are quite remarkable. It is by no means fœtid, as many people suppose, neither is it pungent or ammoniacal. It is rather negative in character, faint in odor, mawkish, smelling, perhaps, more like soap than any other familiar substance.

Sewer-air may escape very freely in our dwellings, before its presence will be suspected, and that this happens very often there can be no sort of doubt. There are many reasons

for this belief. One cause for such escape, and a very active one, is found in the difference of temperature between the interiors of our houses and the interiors of the underground sewers. A rarefaction of air and an upward current are thus induced. The joinings of the soil-pipes are imperfect from alternate expansion and contraction by exposure to hot and cold water, and, unless a free and safe vent is provided above, there must be leakage at these points.

The air of the sewers is also subject to pressure from the sudden influx of water in rain-storms, and in sea-board towns from the action of the tide.

In Boston, all, or nearly all the outlets of the sewers are below the level of the sea at high water. As the tide rises, it displaces sewer-air, which is pressed inwards and must inevitably escape at some of the sewer inlets.

There can be no doubt that the rain-water conductors often serve the purpose of conveying safely away the imprisoned air thus seeking a vent,* an office not generally thought of in their construction. But their usefulness in this way depends upon their being left untrapped, which is not always the case. Frequently, instead of passing directly to the principal house-drain, without obstruction, they enter a water-sealed cesspool. But the rain-conductors, while sometimes acting as drain ventilators, are inoperative when the house gutters and pipes are filled with water in a heavy rain-storm. Neither do they relieve the pressure on the soil-pipes within the house, caused by expansion of the enclosed air by heat. We have then remaining only the water-traps of sinks, bath-tubs, wash-basins and water-closets, as a defence against the air of the sewers.

There is, however, another risk to which the health of the family is exposed through these contrivances, in addition to those which come from upward pressure, or from defective construction of the traps, or from unsoldering of their connections of iron and lead, or from their corrosion and decay by time and use. Whenever a large amount of fluid is thrown down the soil-pipe, whether from the bath-tub or any other opening, the tendency is to the formation of a

* This fact was noticed by Dr. Francis Minot, in the "Boston Medical and Surgical Journal," January 28, 1854.

vacuum behind it, and atmospheric pressure causes a suction upon every trap which is at a higher level. This may be shown, at any time, by pouring down a bucketful of water and observing the commotion which ensues in all the traps above it. It not unfrequently happens that the water of the trap is, in this way, sucked or "syphoned" out, and the pipe consequently remains open to the sewer, and the trap empty, until filled again by the next use of the water.

There is also an obvious escape of the air of the soil-pipe, corresponding with its constant daily use. Whenever fluids are introduced a certain amount of air is displaced and must go somewhere. Unless other vent is provided, it flows directly upwards.

For all these reasons we would advise giving the whole drainage plan of a dwelling the freest possible communication with the outer air at a point so elevated that the sewer gases cannot fail to be diffused and got rid of. This can readily be done, while building, by carrying the soil-pipe, made of iron, at full size, through the roof, and leaving it open like a chimney. By this arrangement all stagnation is prevented; the contents of the house-drains are constantly exposed to the oxidizing and purifying influence of currents of air; when rain-conductors are filled with water there is still free escape for the sewer-gases; and the water-traps throughout the house are relieved from pressure, both of the pent-up sewer-air on the one side, and of suction, or atmospheric pressure, on the other. In houses already built a lead-pipe may be readily carried from the highest point of the soil-pipe directly through the roof; but the larger the pipe, and the straighter its course the better.

In one instance, at least, where this plan has been adopted, a constant current is found to flow outwards, through the pipe.

Sewage from other Sources.

There are other forms of refuse, of a fluid or semi-fluid kind, which may be carried away by force of gravity in sewers. The washings and scrapings of hides, both their outer and inner surfaces; the washings of hogs, after scalding their skins as is practised at hog slaughter-houses; the wash of all slaughter-houses, and of stables; chemicals used in the prep-

aration of leather and morocco; chemicals used in woollen and cotton factories and print works; the fluid waste of rendering establishments and of soap factories,—these are among the most important of this class. But we must add the liquid waste of manufacturing establishments of every description, and to these are joined, in all compactly built towns covered with buildings and paved or macadamized streets, the whole rainfall of the district, amounting to about one hundred tons per acre for every inch of rain.

Other forms of Refuse not Removable by Sewers.

Swill.—Another form of refuse with which we have to deal is the waste of food known as "swill," consisting mainly of bones, meat, farinaceous food in various forms, and vegetables. Sewers cannot be used for getting rid of this stuff. It is too solid, too bulky (far greater than a true economy should allow in most families in New England), and is generally utilized in our towns by methods to which we shall again have occasion to refer.

Ashes.—Still another form of refuse which sewers cannot remove is the ash of various forms of fuel.

Let us now see how all these various kinds of refuse are disposed of at the present time in Massachusetts. A series of questions relating to this among other matters, was addressed to our correspondents in sixty-nine cities and towns of the State, being all which contained four thousand or more inhabitants; we have returns from every city and town. The inquiries under this special head of the disposal of refuse materials were as follows:—

Refuse Materials.—*Solid, Half-Solid and Fluid.*

What is done with ashes?

What is done with meat and vegetable refuse, or swill?

Sewage.

(Including under this term all refuse which may be carried away by sewers.)

What disposition is made of human excrement?

Of fluid slops? including chamber urine?—Kitchen or sink-wash? Soap-suds?

What disposition is made of manufacturers' sewage?

Ashes.

The information received shows that wood ashes are universally used either for making soap, or as fertilizers.

Coal ashes are in rare instances mixed with manure and spread upon land. They are also sometimes, and in small amounts, thrown into privies. But the almost universal use to which they are put is to fill up low and wet grounds, sidewalks and streets.

In the smaller towns, with detached dwellings, they are piled up during the winter quite near the house, often mixed to a greater or less extent with refuse liable to decay, and with too frequent disregard to the proximity of the well; and in the spring are taken away for the uses above mentioned.

In the largest cities provision is made by public authority for the systematic removal of ashes, but in by far the larger number of places, each householder does the best he can with them on his own account.

Meat and Vegetable Refuse.

Meat and vegetable refuse is disposed of in various ways.

The larger bones and the trimmings of meat at markets and provision stores go to the bone-boilers. Near each of our largest towns may be found one or more establishments where the fat of these materials is extracted, and the scrap or tankings either given directly to hogs, or pressed into cakes to be sold for hog or poultry food.

The larger bones are usually reserved, and after being dried, are sold to be made into animal charcoal, or pulverized for use as a fertilizer. The bone-boilers also generally receive dead horses and cattle, to be utilized in the same way. Some of the bone-boilers send their teams great distances, and collect uncooked bones and meat from all the surrounding country.

The meat and vegetable refuse of the household, known as "swill," is generally utilized as food for swine. It is no easy task for the health authorities of any town to regulate the decent distribution of this sour and offensive stuff. In most cases it is done in a slovenly and very unsatisfactory way. Some of our largest cities collect it twice a week by author-

ized scavengers and deposit it in neighboring towns where it is either given directly to hogs, or sold to the swine keepers of the surrounding country. In either case a nuisance is the consequence, and sometimes these depots for swill are so offensive as to prevent the improvement of the adjacent lands. In other populous cities and very many large towns, the citizens dispose of this refuse from their houses, by giving it to the children of Irish swine-keepers, who collect it in pails and wheelbarrows, and slop it about the premises.

This is allowed by the health authorities of cities like Springfield, Salem, Lynn, Fall River, Lawrence and Holyoke.

In Fall River the mixture of swill with ashes is also permitted. This practice (a very common one out of New England, but a very uncommon one in Massachusetts) has some sanitary advantages. In hot weather the sour decay of vegetables may be thus rendered less offensive, and perhaps also less dangerous. But it happens that at the season when a large supply of ashes is needed to cover up the swill, only a small amount can be had from the kitchen fire. This mixture is indeed an imperfect application of the "dry-earth system" to the solid refuse of the kitchen.

A great sanitary disadvantage must also be recognized when ashes, polluted by swill, are used for filling land on which dwellings may be subsequently built.

In the smaller towns every household is left to its own resources, and swill is generally thrown into the family pig-pen, or is given as food to cattle, poultry, dogs and cats. It is often cast into the privy, or the barn manure-heap; sometimes into the kitchen drain (blocking it up in time), and among very careless and slovenly people it is thrown out upon the surface of the ground.

Sewage.

In the inquiries made of our correspondents, sewage was subdivided, but in the replies this distinction was not always preserved, and the information thus collected will be the better understood if we sometimes class together all the various forms of fluid or semi-fluid waste which sewers are fitted to convey.

It is to be remembered, however, that human excrement is by far the most important of sewer contents, whether regarded from a sanitary or economical point of view.

All the cities and towns may be classified thus:—

1. Those which have good, or complete sewers.

2. Those which have sewers more or less complete, or in process of construction.

3. Those which have no sewers.

The water-supply in each case will be reviewed in another part of this Report, but it will be now seen to have a close connection with the sewerage. The two systems are intimately joined. When people are massed together in crowded towns, the local supplies of water inevitably fail, and it must be finally brought to them from without, and having been so brought and used, it must then be carried away again. Sewers thus become a necessity.

The only cities in Massachusetts now provided with a system of sewerage which can be regarded as approaching completeness, are Boston and Worcester. In Boston it has grown out of the absolute necessities of a very crowded population. Some of the sewers date from a very early period in the city's history, and were originally provided to drain the springs, and thus followed the line of old water-courses to the harbor. Additions have been made at all subsequent periods, until there are now one hundred and twenty miles of sewers. The filling up of very large tracts redeemed from the sea on all sides of the city has seriously complicated the system of sewerage. More than half of Boston is thus elevated but little above high-water mark, and the grade of the sewers is correspondingly unsatisfactory. We regret to say that authority to erect buildings has been given of late years very freely in sections which cannot be properly sewered, and which must subsequently be raised at enormous cost.

Of the various forms of matter included under the head of sewage it is estimated that in Boston about one-half of the whole amount of human excrement is now carried away by sewers, and the other half (5,000 cords per annum) is deposited in vaults and subsequently removed in carts by night, to the neighboring country. Of the other constituents of sewage very much more than half is swept away by the sewers.

It seems also very certain that in addition to the 5,000 cords of excrement removed by hand labor, a great deal of the fluid portion sinks into the earth through imperfectly constructed vaults and cesspools, and finally reaches the harbor either through the sewers, which, however built, drain the soil to a certain extent, or by direct passage.

Worcester has recently adopted a system of sewerage, and has had the great advantage of being but little hampered by previous constructions. These works are on a very complete scale, and are a subject of just pride to the city and Commonwealth. If their cost has been great their advantages on the score of health, comfort and convenience will be in corresponding measure, and they will benefit that prosperous city in all coming time. These sewers may be reasonably expected at an early day to convey without the city in a safe and convenient manner its whole fluid and semi-fluid refuse. They are already very extensively used.

Lynn, Fitchburg, Lowell and Holyoke are following Worcester in establishing a complete system of sewerage. Medford is discussing the question, and has recently employed an engineer to report a plan.

Taunton, Salem, Danvers, Milford, Brookline, Haverhill, Springfield, Somerville, Pittsfield, New Bedford, Middleborough, Lawrence, Grafton, Fall River, Chicopee, Charlestown, Cambridge and Amesbury are partially provided with sewers at public cost, which are capable of removing fluid and semi-fluid waste. In other places natural water-courses running through the roads and streets, are, to a certain extent used under public authority to convey away this refuse, and in very many others the streams on whose banks towns have grown up, have private drains leading from factories and dwellings, into which sewage is conducted.

There are many large and thriving towns in which the citizens are following the old traditions with regard to the removal of refuse, without as yet comprehending the new requirements which their growth has gradually brought about. They are without sewers, and their sewage is left to be a source of offence and of danger to public health. Among them may be mentioned North Adams, Hyde Park, Hopkinton, Gloucester, Northampton, Woburn, Dedham, West Roxbury,

Hingham, Marblehead, Stoneham, Randolph, Webster, Ware, Watertown, Waltham, Wakefield, Stoughton, Rockport, Quincy, Peabody, Newton, Natick, Great Barrington, Clinton, Blackstone, Beverly, Barnstable, Attleborough, Amherst and Abington.

There are some cities and towns in which the water-supply is abundant, and the sewerage deficient. Excellent water is brought to every house, but no adequate provision made for carrying it away after it has served its purpose. The benefit of the large supply is thus greatly qualified, and in low and damp places it becomes a real disadvantage. The water and fluid waste are, in such cases, spilled upon the ground, or in case water-closets are used, the contents are led into cesspools * in gardens or back yards.

Excepting the houses directly connected with sewers, and the houses provided with cesspools connected with water-closets, as above referred to, and the houses provided with a stated supply of dry earth or ashes, and the means of applying them, the same general remarks will apply to the whole population, in speaking of the prevailing modes of disposing of human excrement, and the fluid waste of the kitchen and household, and the fluid waste of manufacturing establishments.

In the vast majority of households in Massachusetts, human excrement is deposited under small buildings, either entirely detached from the dwelling or connected by a wood-shed or other covered passage-way. These buildings (privies) may have a brick vault or may merely cover a hole dug in the earth. In either case, unless unusual care is taken in the construction, the liquid portions, in which are contained four-fifths of all the value as manure, soak into the ground. From beneath these buildings the solid contents are removed from time to time, and put directly on the land as a fertilizer, or mixed with loam, or barn-manure, or ashes, before being so applied.

* This word *cesspool* really signifies not only a pit for the deposit of insoluble matters, as stones, sand and solid refuse, which may get into drains and sewers, but also an arrangement by which the passage of air may be prevented—as seen in its simplest and perhaps best form, by making the outlet at a higher level than the inlet. The word is, however, generally applied in Massachusetts, to any enclosed pit, whether in a line of drainage, or at its terminus, and whether trapped or otherwise.

This plan of privies with vaults has much to recommend it in a sanitary view, provided the premises are kept clean, and the product is not allowed to accumulate in great amounts, or is systematically covered with dry earth or ashes; but it is attended with special dangers also. If not looked after by careful and intelligent persons, a privy becomes an offence to its neighborhood, both above and below ground. It infects both the air and the earth. It may readily poison the air which the family must breathe, and the water which they must drink. A neglected privy in the neighborhood of a well, or any privy within thirty or forty feet of a well in soils of ordinary porosity, will affect the purity of the water, as may be seen by careful analysis at any time, and as may be demonstrated when least expected, by fevers, dysenteries and intestinal disorders.

There is great need of vigilance on the part of town boards of health concerning this condition of privies. Physicians know very well the danger, but often find it hard to convince their fellow-citizens. In the boarding-houses of the smaller woollen and cotton mills, all over the State, the foul state of these privies calls for special notice.

In the boarding-houses of the larger establishments, more care is used. In boarding-houses occupied in the summer months by visitors from cities and crowded towns, the offence to which we have referred is a frequent cause of illness.

House vaults in the larger towns are emptied by public authority; the householder notifying the board of health and paying a certain sum for each load removed.* This is generally done by night and in the colder season of the year, but neither of these restrictions are observed in all the towns.

In the smaller towns it is a common practice to sacrifice the value of human excrement as manure, and bury it by the side of the privy in deep holes dug for the purpose.

* It would be conducive to public health in our cities and large towns if all privies were emptied at public cost, as well as by authorized persons. The householder is now tempted to let their contents accumulate until they overflow, or the walls break away, thus endangering the health of the whole neighborhood. Or, perhaps a more equitable and equally safe arrangement would be, to have every privy vault inspected at certain intervals by authorized persons, who should decide when it should be emptied and when it should be repaired, both operations being at the householder's expense.

In the open country it is universally applied as manure to the soil, in some of the forms above mentioned.

As regards the other chief constituents of sewage, viz.: 1, chamber urine; 2, kitchen and sink wash; 3, soap-suds, —they go into sewers wherever sewers exist. Under other circumstances, among decent people, the first named goes to the privy vault. The expedients resorted to for the sake of being rid of the other two are many and various. Sometimes a drain from the kitchen conducts these fluids into a pit (generally called a cesspool), from which they either soak into the earth, or are in part preserved for watering the neighboring plants. Occasionally we may find two pits, one to receive the contents of the water-closets, and the other for kitchen wash. Sometimes the latter is carried to the barn manure-heap. A hogshead sunk in the earth often forms the pit for kitchen wash. Frequently, however, all these slops are thrown on the ground at the backdoor. In a great majority of country dwellings, a short spout may be seen projecting from the rear wall, out of which flows all the fluid waste of the kitchen. This is frequently conducted by an imperfect drain of wood or flat stones to some neighboring depression in the ground, or to the highway, or it is left to soak into the earth by the side of the house. The latter is too often the case. In many instances, this constant dropping on a limited space has gradually made an underground direct passage to the family well, which drains the whole vicinity. One of the best ways to dispose of these slops in isolated dwellings, where the conformation of the ground permits, is to conduct them by a tile-drain to a point a hundred feet from either the house or the well, and to plant grape-vines about the outlet.

Sewers.

These constructions play a most important part in the preservation of public health. Hidden, and consequently but little thought of, they are, in crowded cities, our constant and faithful servants, removing from among our dwellings, yards and streets, not only the superfluous rain, but every fluid and semi-fluid form of refuse matter, which if allowed

to accumulate, would pollute the air and cause pestilence, as it did in European cities centuries ago.

A system of sewerage receives its fluid contributions from every house, and conveys them to a remote and safe place of deposit by channels of constantly increasing size. It is the reverse of the plan of water distribution, when the supply is from a distant point. Both systems are represented by a tree and its branches, and both depend on gravity for the motive power.

Sewers may be used, 1st, for the exclusive removal of excremental and waste fluids; 2d, for the removal of rainfall; 3d, for the removal of superfluous water in the soil.

There are those who strongly advocate the separation of the first two from each other. "The rainfall to the river, the sewage to the soil" is an alliterative saying which has had great currency in England. It however, involves the construction of a complete double set of sewers in every case, and it sacrifices the advantage of occasional flushing and complete washing out of these conduits by violent rainstorms. Our best engineers do not advise this separation, except to provide "storm water overflows" as a measure of economy. With such outlets, a system of sewers may be made of less capacity, and at less cost.

The question of the expediency of uniting the first and second uses with the third, is one not readily answered in theory, and in practice is attended with great difficulty, whichever may be considered the better plan.

There can be no doubt whatever about the great sanitary advantage of thoroughly draining the soil on which we live. It is also very important that the contents of sewers should not leak into the soil through which they pass. These conditions are both theoretically fulfilled, when the grade of the territory permits, by having a double system of conduits, one placed above the other: a drain-pipe of pervious structure, like that described in another article of this volume on the drainage of country dwellings, being laid directly beneath a sewer built of materials absolutely impervious to water.

Practically, however, sewers drain the soil to a greater or less extent. It is exceedingly difficult to prevent this effect, whether the sewer be of wood, brick laid in cement, or even

vitrified drain-pipe. The water enters at the joints, if nowhere else. And, on the other hand, when sewers are full,—as for instance, at high tide in Boston,—there is a corresponding leakage outwards. No absolute rule can be laid down which will suit all cases and all grades. It is a question of engineering practicability and of sanitary advantage. No doubt a system of sewers built of iron and jointed, like the water-mains of our great cities, might exclude the soil-water, and might be underlaid by drain-pipe, but even when practicable, the enormous cost of such constructions puts them out of the reach of our towns.

The best we can reasonably hope for is that the centres of population and active industry in Massachusetts shall be furnished with sewers, arranged by competent engineers on a complete system, capable of indefinite extension as population extends, and that these sewers be built of brick or of glazed drain-pipe, either of which will last for generations.

Sewers now in use in Massachusetts.

Each of the sixty-nine towns containing four thousand inhabitants has sent a reply to the following questions :—

Where a system of sewerage exists in the whole or part of a city or town, please describe it, in so far at least as to show whether the sewers are—

Of brick.
stone-masonry.
cement.
wood.
iron.
Scotch drain-pipe.
other forms of earthenware or pottery.
flat stones.

As we have before stated there are very few cities in Massachusetts provided with a system of sewerage which can be regarded as satisfactory; completeness in this respect can hardly be expected in cities growing with great rapidity. Worcester must certainly head the list with a comprehensive arrangement of sewers built, after a well-devised plan, of stone-masonry, brick and cement-pipe.

Boston is provided in different parts of its now large territory with sewers of many kinds. Sewers, when carefully built, are very durable constructions and require few repairs.

Many of those in Boston date from an early period in the town's history, and still do good and faithful service. There are five miles of stone-masonry, sixty-seven miles of brick-work, two miles of cement-pipe, fifteen miles of wood submerged at high-water, ten miles of Scotch pipe, one mile of other earthen pipe, and twenty miles built with dry-brick sides, covered with slate.

Sewers now in course of construction at Holyoke are chiefly of brick. At Lynn, twenty-one thousand feet of sewers are of brick and eight thousand feet of Scotch drain-pipe.

In the other sewered towns we find in recent constructions the same enduring and trustworthy materials used as at Worcester, Holyoke and Lynn. Cement pipe is also extensively employed, and is approved by engineers of repute.

In the oldest towns, sewers of *flat stones* are still in use to some extent, and in many towns which have not kept up with the advance of knowledge in this direction they have even been built of late years. Nothing in the shape of a drain, or purporting to do the office of a sewer or drain, can be more unsatisfactory. They fail in every way. The dirt and rubbish lodges in their angles and obstructs them. Water passes in and passes out with perfect freedom in their best condition. There can be no excuse for making such conduits for liquid waste in the future, when vitrified pipe and cement pipe are to be had at moderate prices.

Outlets of Sewers in Massachusetts.

Where are the contents of sewers discharged? This question is readily answered. We know of but two directions which are taken by the sewage of all our cities and towns. It is discharged either directly into the ocean or *into the nearest water-course.* Whether these water-courses be brooks already notoriously foul, or streams from which no one will drink, like the Blackstone and Neponset Rivers, or others in gradual process of spoiling, like the Nashua and Housatonic, or rivers like the Charles, on whose banks preparations are now making for the supply of drinking-water to large towns, or great rivers like the Connecticut and Merrimack—it makes no difference—the liquid refuse of all living on their banks is added to the stream.

In a sanitary view of the question we believe that *in the present state of human knowledge and experience*, no better receptacle than the ocean can be found, provided the sewage is delivered where deep currents can disperse it so that it shall be no more seen, and can prevent its deposit in the settling-basins of docks and the mud-flats of estuaries.

Streams are practically used as sewers, not only in Massachusetts but everywhere else, except in the face of the most stringent regulations and a police vigilance such as can only exist under a government of despotic power.

The temptation to cast into the moving water every form of portable refuse and filth, to be borne out of sight, is too great to be resisted. It is felt as strongly by municipalities as by individuals. What becomes of this refuse lower down the stream is a matter of little concern. It is got rid of at any rate, and those who thus dispose of it, if they think at all about its final destination, hope that the stream will purify it in some way, so that it will be no longer a nuisance and offence. Wherever a constant stream of water flows past a dwelling, or a collection of dwellings, or a factory of any description, it receives contributions of this kind.

It will be seen in another part of this Report what effect such additions of decaying materials must have upon the purity of the waters into which they are thrown, to what degree a running stream is capable of clearing itself from contamination, and the probability of even our largest rivers ultimately becoming sewers unless some practicable means be found of diverting this filth from their currents.

On the Treatment of Sewage.

Having already shown that, as a rule, the best method of getting rid of excretal and other refuse matters is by means of the water-carriage system, the question arises,—what shall be done with the sewage? The problem presents itself in two aspects; first, from the sanitary point of view,—how shall this matter, ready to putrefy, be got out of the way without injurious effects upon the community? second, from the economical point of view,—can the valuable fertilizing ingredients of the sewage be turned to account without an outlay greater than the return?

That so large an amount of excretal matter as finds its way into the sewers, especially where an abundant water-supply has led to the general adoption of water-closets, should go to waste seems at first sight to be a manifest absurdity, but if its recovery involves an expenditure greater than the value of the material recovered, then the true economy is found in the apparent waste. Thus there are portions of many articles, both of necessity and of luxury, which are daily cast away by common consent. Their intrinsic value in the aggregate is very great, but the cost of the labor involved in combining and utilizing them would be still greater.

It may, however, be necessary in the interest of the health of the community, that some process of treatment should be devised by which sewage should be rendered innocuous; if at the same time this process may be made to return a part or the whole of the outlay involved, so much the better.

Approaching the investigation of this subject without prejudice, in the light of the experiments carried on in England, and comparing the condition of things there with those which now exist in this country, we have been led to the conclusion that it is possible to purify the sewage, so that it may be discharged into running streams without rendering them a nuisance; without making the water too impure for use in manufacturing operations; without killing or driving away the fish which may inhabit them;—in short, without materially injuring them for any purpose, except as sources of water-supply for cities or towns. We are led also to the conclusion that no process of *utilizing* sewage has yet been proposed by which, unless in exceptional cases, its purification can be made a source of real profit, although the purification may be so conducted that there shall be some pecuniary return.

In giving the reasons which have led us to these conclusions, we propose first to describe, as briefly as possible, some of the many processes which have from time to time been proposed; we shall consider the results of the practical experiments which have been carried on in England, where the subject of the treatment and utilization of sewage has for a long time occupied the thoughts of chemists, agriculturists and engineers. We then propose to present the results of a number of analyses of the sewage from two of the largest

cities in Massachusetts, and to show how far the processes which have proved satisfactory in England, will bear application to the altered conditions of climate and other circumstances here.

Our information with regard to the investigation of the subject in England, is derived mainly from the published reports of the commissioners appointed by Parliament in 1865, "to inquire into the best means of preventing the pollution of rivers;" from the reports of a second commission appointed in 1868; from the reports of the British Association Committee on the treatment and utilization of sewage; from Dr. Corfield's most excellent work on the same subject; and from a variety of pamphlets to which the very general discussion of the subject has given rise. Morever, one of the authors of this report, during a few weeks' stay in England the past summer, had opportunity for conversation with many of the authorities on the subject, and to visit some of the localities where processes of purification or utilization are carried on.

In the first place, what is the nature, the chemical character of the liquid with which we have to deal? Sewage is a very complex liquid, consisting not only of human excreta dissolved or diffused in water, but also of water rendered impure by a great variety of substances, such as the soap-suds and other refuse from the kitchen and laundry, and in many cases the drainage from manufacturing establishments. The chemical character of the English sewage may be best seen by an inspection of Table I, where are collected some analyses selected from a great number made by the Rivers Pollution Commission.* To determine the average composition of sewage with anything like exactness is quite difficult on account of the very great difference in its composition at different hours of the day and night. The average composition employed by the commissioners for purposes of comparison is given in the table as well as the maximum and minimum results obtained in the examination of the samples from which the averages were made up. The results are stated in parts per 100,000.

* First Report of the Commissioners appointed in 1868, to inquire into the best means of preventing the pollution of rivers. (Mersey and Ribble Basins.) Vol. I. Report and Plans. London, 1870.

TABLE I.—*Composition of English Sewage.* (Results of Analyses expressed in Parts per 100,000.)

DESCRIPTION.	Total Solid Matters in Solution.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrites and Nitrates.	Total Combined Nitrogen.	Chlorine.	Suspended Matters.		
								Mineral.	Organic.	Total.
Average of 50 samples of sewage from 16 water-closet towns,	72.2	4.696	2.205	6.703	0.003	7.728	10.66	24.18	20.51	44.69
Maximum,*	117.8	16.335	4.977	25.960	0.076	24.325	21.50	182.80	56.28	234.16
Minimum,*	41.2	1.104	0.680	2.030	0.000	2.371	4.00	0.84	3.36	4.94
Average of 37 samples from 15 midden towns,	82.4	4.181	1.975	5.435	0.000	6.451	11.54	17.81	21.30	39.11
Maximum,*	419.6	11.012	7.634	30.350	0.000	30.638	21.50	79.68	52.12	131.80
Minimum,*	31.1	1.288	0.357	0.380	0.000	1.592	6.50	4.14	4.46	8.60
Average composition of sewage. Standard taken by Commissioners,	64.5	4.386	2.484	5.557	0.000	7.060	10.4	–	–	–
Average Norwood sewage, 1868–69,	94.9	3.972	1.586	6.032	0.000	6.554	8.66	–	–	–
Average Croydon sewage, 1868–99,	45.7	2.508	1.051	3.006	0.000	3.527	4.23	–	–	–

* These figures do not, of course, represent the composition of any one sample.

Value of the Sewage.—There are several ways of estimating the value of sewage with more or less accuracy. In the first place, knowing, from numerous analyses, the composition and average daily quantity of the fæces and urine of one person, we can calculate from the number of inhabitants the average quantity of fertilizing material which would naturally find its way to the sewers of a town provided with a complete sewerage system; or the value of the sewage may be calculated from the examination of a large number of samples taken under a great variety of conditions and at all hours of the day and week. By the first method of computation no account is taken of other than human excrementitious matters, but as these form by far the largest amount of useful matter in the sewage, the results obtained are sufficiently accurate. Moreover, it is to be considered that, although the value of the fertilizing ingredients of a certain amount of sewage might in the dry state be worth a certain sum, yet this value may be very sensibly diminished when the material is diluted with the large amount of water by which it is accompanied.

The value of the annual voidings of an average individual of a mixed population of all ages and both sexes is variously estimated at from 6*s.* 8*d.* ($1.61) to 8*s.* 4*d.* ($2.01). The value assigned to "average" sewage by the Rivers Pollution Commission is 17*s.* ($4.10) per 100 tons (2,240 lbs.) or about 2*d.* (4 cts.) per ton. Although the amount seems small when we consider the value of the excreta of a single individual or the value of a single ton of sewage, yet when we reckon the entire annual amount of the sewage of a large town, we find that the total money value is very great. For instance, the sewage of London has been estimated to amount to 260,000,000 tons annually, and reckoning its value at only one penny a ton, the total value would be £1,108,-333, or about $5,000,000. Estimating the value of the sewage of London from the number of inhabitants, the annual value of the entire sewage would lie between £1,000,-000 and £1,250,000.

In view of these statements, the question would, of course, very naturally arise: Can the valuable material contained in the sewage be recovered in manageable form, so as to prove a source of profit? The attempts so to do are prosecuted in

England, the more from the fact that the discharge of sewage into running streams creates such a nuisance that many towns are under an injunction to prevent their disposing of their sewage in this manner: in many cases the sewage must be rendered innocuous.

The recovery of three or four cents' worth of fertilizing ingredients from a ton of liquid* by chemical means, so as to make the operation a profitable one, appears at first sight a discouraging problem. There have not been wanting, however, those who have attempted its solution. Allusion will be made only to some of the more important schemes that have been suggested, and first to one of the oldest, simplest and cheapest,—the lime process.

Lime Process.—The lime process consists in mixing the sewage with a certain proportion of milk or cream of lime, agitating the mixture violently and then allowing it to subside. There settles from the mixture a copious precipitate of a highly putrescible mud, while the liquid flows off in a tolerably clear condition. As far as purifying the sewage is concerned, the process is a failure. At the time of the visit of the Rivers Commission to Blackburn, where the process was in operation, their note on the condition of the river below the outlet of the limed sewage was as follows:—"Horribly offensive, turbid, blackish stream, disengaging most offensive gases, with black masses of putrid mud floating on the surface." This may have been an exceptionally bad case; under skilful management the process suceeeds better than here represented. It is certain, however, that the purification effected is but slight, and that the attempt at purification under careless management is worse than useless.

Nor as regards the production of a valuable and saleable manure, has the project proved successful? The suspended matters are, to be sure, removed from the sewage, but these contain only about one-tenth of the valuable constituents: of the dissolved substances, there is removed about one-half of the putrescible organic matter which was in solution, and a portion of the phosphoric acid. The drying of the mud, as

* It will appear presently that the sewage of Boston and Worcester contains even less valuable matter than this amount.

ordinarily conducted, is an offensive operation, and its value when dried, as estimated from chemical analysis, lies between 15*s.* and 17*s.* per ton ($3.62–$4.10). But it was stated that at Leicester the semi-solid manure was bought sparingly by farmers at 1*s.* per ton. This amount is only about one-third of the actual expense of its production.

The use of lime as a precipitant, previous to employing the sewage for irrigation, will be spoken of in a succeeding section.

Blyth's Process.—This process, which has been proposed and tried at various times both in England and in France, attempts to recover the ammonia in the sewage; it consists in the addition to the sewage of super-phosphate of lime and a salt of magnesia, under the supposition that an insoluble phosphate of magnesia and ammonia would be thrown down. It is, however, unfortunately the case that this compound is insoluble only in the presence of an excess of ammonia. Moreover, Professor Way's analyses show that a third part of the phosphoric acid added is left in the solution and constitutes an absolute loss to that extent. The Sewage Commissioners reported that "without accomplishing any part of its intended object, it is the most costly of all the plans that have been proposed."

Holden's Process.—This is a patented process which has been tried at Bradford and consists in mixing the sewage with sulphate of iron, lime and coal dust. The process was examined by the Rivers Pollution Commission who were led by their analyses to conclude that while this process "separates the whole of the suspended matters, it not only fails to remove the putrescible organic matters in solution, but actually (as measured by the organic nitrogen contained in these organic matters) increases their quantity. This it does by causing some of the putrescible organic matters in suspension in the original sewage to pass into solution. The effluent water could not therefore be admitted into rivers without causing pollution. Further, the very large amounts of lime and sulphate of iron added, not only enormously increase the amount of solid matter in solution, but, by their mutual de-

composition into hydrated oxide of iron and sulphate of lime, they communicate to the effluent water a degree of permanent hardness so excessive as to render its admixture with water to be afterwards used for manufacturing purposes extremely objectionable."

An analysis of the air-dried mud showed the presence of only 0.3 per cent. of phosphoric acid, 0.004 per cent. of ammonia, and 0.555 per cent. of organic nitrogen. "A manure of the above composition may be considered as practically worthless."

A. B. C. Process.—Of all the plans at various times proposed for the purification of sewage, perhaps no one has awakened greater interest than Sillar's Patent, commonly known as the A. B. C. process. The patent is in the hands of a stock company, and the representations of those interested in the company are of the most favorable character. It has, moreover, been deemed by the Rivers Pollution Commission of such importance that they have given an entire report to the details of their investigation of it.* The following is an extract from the specification filed by the patentees:—

"We add to the sewage to be purified a mixture consisting of the following ingredients:—Alum, blood, clay, magnesia, or one of its compounds, by preference the carbonate or the sulphate, manganate of potash, or other compound of manganese, burnt clay otherwise known as ballast, chloride of sodium, animal charcoal, vegetable charcoal, and magnesian limestone. Of these substances the manganese compound, the burnt clay, chloride of sodium, and magnesian limestone may be omitted, and it is not essential that both animal and vegetable charcoal should be used. If any of the ingredients named should from any cause be present in sufficient quantity in the sewage it may of course be omitted from the mixture. The proportions in which the ingredients are to be used vary according to the nature of the sewage to be purified; as, for instance, if a large proportion of urine is present we increase the proportion of clay; if the sewage is much diluted we slightly increase the proportion of alum and blood; if it contains a large proportion of street refuse we decrease the proportion of clay."

From the quantities employed it is evident that many of the substances mentioned in the above specification are non-essential: the essential ingredients of the A. B. C. mixture are alum, blood, clay and charcoal. These materials in proper proportion are mixed with water and run into the

* Second Report of the Rivers Pollution Commission. The A. B. C. Process of Treating Sewage. London, 1870.

sewage in a continuous stream: the mixture is then subjected to violent agitation, and allowed to subside in tanks. A heavy flocculent deposit soon settles to the bottom of the tanks, and the clarified liquid is discharged into the river or into tide-water as the case may be. When enough of the sediment has accumulated in the tanks it is removed, dried in a Needham's press or on drying-floors and then offered as a manure.

The proprietors of the patent, the Native Guano Company, limited, claim for their process two advantages: first, that it purifies the sewage to such an extent that it may, without harm, be discharged into a river; secondly, that they produce a valuable manure, a manure costing about 25*s.* a ton to manufacture, and worth, at least, their selling price, £3 10*s.* ($17) a ton.

As already stated, the process has been subjected to a searching investigation at the hands of the Rivers Commission. As there is no reason to suppose that the Commissioners were actuated by any motive other than a desire to ascertain the truth in the matter, full weight must be given to the result of their examination. It will not be necessary in this place to detail the results of their analyses, nor the methods they employed; it will suffice to give their conclusions. They say:—

"Our investigations into Sillar's or the 'A. B. C.' process of treating sewage, as carried out at Leicester and Leamington, extending over nearly two years, have led us to the following conclusions:—

"1. The process removes a large proportion of the *suspended* impurities from sewage, but on no occasion, when we have seen it in operation, has this removal been so complete as to render the effluent sewage admissible into running water.

"2. The 'A. B. C.' process removes a very small proportion of the soluble polluting matters from sewage. After treatment by this process, the effluent sewage is very little better than that which is obtained by allowing raw sewage to settle in subsidence tanks.

"3. * * * * * * * * * *

"4. The manipulations required for the extraction and drying of this manure are attended with a nauseous odor, especially in warm weather, and would occasion a serious nuisance if the works were situated in or near a town."

It is stated that the effluent water, in a very few days, becomes not only putrid, but nearly if not quite as bad as the

original sewage and this is what would be expected from the analyses published.

We visited this summer, the experimental works at Crossness, where about 500,000 gallons of London sewage can be daily treated, and the works at Leeds, where a portion of the town sewage is subjected to the A. B. C. method of purification. At Crossness the sewage of all of London south of the Thames is received and pumped by steam-power into huge storage tanks, from which at low tide it is run out into the river. The Native Guano Company take a portion of the sewage from these tanks, and after subjecting it to their treatment run the effluent water into the river. From the nature of the case it is thus impossible to distinguish the effect of the purified sewage on the river from that of the raw sewage which is discharged in close proximity to it. The difference in the appearance of the foul, black London sewage received at the works, and the nearly clear and odorless liquid which, after the purification, is discharged over a miniature fall into the Thames is most striking. The sense of sight and that of smell concur in pronouncing an amelioration effected. The works at Crossness are arranged with neatness and taste so as to strengthen the favorable impression made upon the casual visitor. To form, however, just conclusions of the efficiency of the process, the results of the chemical analyses must be relied upon.

At Leeds the portion of the sewage which has been subjected to the A. B. C. treatment runs back into the canal through which the main body of the sewage flows, and here there is no opportunity for judging of the completeness of the purification. It is to be remarked that the town of Leeds is so well satisfied with the process that arrangements are being made to treat the whole of the sewage in this way. On the other hand, Leamington, where it was in use for a time, has given it up and is making arrrangements to utilize its sewage by irrigation. Both at Crossness and at Leeds the matter deposited in the settling tanks was allowed to drain and then dried on heated iron plates. At both places, however, arrangements were being made to dry the sludge by means of a Needham's press; the drying on the floors was, at least, at

the time of our visit, attended by no such disagreeable odor as has been attributed to the operation.

As regards the value of the manure produced, the so-called "native guano," the statements made with regard to the amount of purification effected in the sewage will lead to the supposition that it cannot possess any great value above that of the materials employed. It is asserted, however, by the proprietors of the patent, that the manure is readily disposed of at the selling price, £3 10*s.* ($17) per ton, and their circular contains certificates from those who have used it, attesting its great value. Much weight cannot, of course, be placed upon such statements, as no artificial fertilizer, probably, was ever brought into the market without a host of certificates to its extraordinary properties. Those who are opposed to the process, or disbelievers in it, doubt the genuineness of many of the sales, and point to the mass of the accumulated manure at Leeds, which is not put upon the market. The A. B. C. manure consists virtually of the insoluble matters of the A. B. C. mixture, of which a large proportion is nothing but clay, together with the suspended matters of the sewage and about one-half of the nitrogenous organic matter previously held in solution. The Rivers Pollution Commissioners consider the native guano "theoretically worth probably one-half more than that resulting from the Leicester lime process, twenty tons of which, according to a chemical valuation, ought to be worth as much as one ton of Peruvian guano, but for which not more than one shilling per ton can be obtained from the farmers of the district."

Dr. Voelcker finds the value of the manure, as estimated from chemical analysis, to vary from 14*s.* 6*d.* per ton to £1 13*s.* 6*d.*

Messrs Lawes and Gilbert, who are eminent as authorities on the subject, give their opinion with reference to the value of the A. B. C. manure as follows:—

"Assuming such a manure to be produced in large quantities, our opinion is that it would certainly be worth more per ton than stable-dung, provided the nitrogenous substance were in an easily decomposable condition, and its nitrogen readily available, and provided the phosphoric acid were also in a readily soluble condition; but if the nitrogen and phosphoric acid were not in such conditions, it may be a question whether the 'A. B. C.,' deposited manure or stable-dung would be the most valuable. The result would de-

pend in a measure on the quantity of the respective manures in the market, the cost of carriage, and other local circumstances. Stable-dung would, however, probably have the preference for market gardening."

Phosphate Process.—Various other attempts besides those already described, have been made to purify sewage by chemical means. Perchloride of iron alone or with addition of lime, salts of zinc and manganese, carbolic acid or carbolate of lime, have all been employed. The most favorable result obtained is the clarification of the water and the delay of the putrefaction which, however, inevitably sets in after a longer or shorter time.

The phosphate process devised by David Forbes, F. R. S., and Dr. A. P. Price, deserves individual mention, if for no other reason, from the fact that its devisers do not claim everything for it. The process may be best described, and its claims understood, by the quotation of a few extracts from a paper read by David Forbes, F. R. S., before the British Association at its meeting in 1870 :—

"This process is founded on the fact that certain mineral phosphates, easily obtainable, especially those containing alumina, when in a hydrated or freshly precipitated state, eagerly combine with the organic matter contained in the sewage, it being sufficient merely to agitate them in the most fœtid sewage to deprive it of all its odor and color, even if tinctorial substances of great intensity be present in the solution at the same time; while the phosphate of magnesia combines with the ammonia contained in the sewage, and precipitates it also in the state of the double phosphate of ammonia and magnesia. The precipitate subsides rapidly, and the water drawn off is quite transparent, colorless, and has so little perceptible taste, that you can drink it without repugnance if you can only banish the idea from your minds that it has only just been obtained from so filthy a source.

"The process is an extremely simple one, and requires nothing beyond a reservoir for holding the sewage whilst it is submitted to the operation. The phosphates are preferably added, in the state of solution, in sulphuric or hydrochloric acid, to the sewage, and their precipitation, in the hydrated form, along with the organic matter in the sewage, and more or less of the ammonia (dependent on the strength of the sewage and amount of time allowed to stand), is instantaneously effected by the addition of a small quantity of milk of lime, just sufficient to neutralize the acid which holds them in solution, the deposit subsides rapidly, and the supernatant water may at once be run off and discharged into the river. * * * As regards the phosphate process, we do not claim that the effluent water is by anything like as pure as the water supplied for drinking purposes, but are content with showing that it is as transparent and colorless as ordinary river-water ; that it can be taken into the mouth, and even drunk, without repugnance; that fishes can live in it; and, most important of all, that it is not

only free from any offensive smell, but, as in the specimen on the table before you, has remained for months, during the entire hot summer of this year, without showing any tendency to putrefy or emit any disagreeable odor."

The statement with regard to the delay in the setting in of putrefaction in the effluent water would seem to be borne out by experiments on a large scale; it would seem, however, from analyses made by Dr. Voelcker, that the amount of ammonia carried down by the precipitate is practically nothing, and it is probable that even when lime is added a greater or less proportion of phosphoric acid goes off in solution. The manure is of course valuable on account of the value of the phosphates used in its manufacture; it is not probable, however, that its manufacture could be made a means of profit. As preceding the use of the sewage in irrigation the process might under certain conditions be of value.

In view of the rapid advances made from year to year in all the natural and physical sciences, it would be hard to say that we shall never be able to purify sewage and to obtain in concentrated form its valuable ingredients by some purely chemical process. The large amount of the accompanying water, the solubility of the salts of ammonia which are the chief fertilizing substances, make the prospect exceedingly doubtful. It is, moreover, true that up to the present time no satisfactory plan has been devised. While some of the processes already described, and others which we have not felt necessary to mention, have had their ardent advocates, the mass of those who are to be considered authorities on the subject have come to this conclusion: that the only way at present available for *purifying* the sewage is that afforded by *filtering it through natural soil.* The purifying power of natural soil is very great; and if sewage be applied to land properly drained, the organic matters are entirely destroyed, that is, are converted into innocuous compounds.

Early in the history of the sewage difficulty, attempts were made to purify the sewage by simple filtration through beds of gravel or ashes; the best effect in any case produced was the removal of the suspended matters; the amount of dissolved impurities not being appreciably lessened. The black,

solid matter separated by this straining process was mixed with street-sweepings and ashes and sold for manure.

Differing from these crude efforts in many respects is the method known as "intermittent downward filtration" through natural soil. The cleansing powers of soils vary very much, the difference being, in great measure, due to differences in porosity and state of division; still all soils have very considerable cleansing properties, and if the sewage be supplied in not too large quantities, it will, after passage through the soil, issue as a clear, odorless effluent water, containing very little ammonia or organic matter, the nitrogen which is present being almost entirely in the state of nitrates and nitrites. It is essential that the sewage should be supplied to a given portion of soil *intermittently* and that there should thus be given to the filter-beds an opportunity for aeration.

The Rivers Pollution Commission conducted a great many experiments on the purifying power of various soils. That which gave the most favorable results was a light, yellowish-brown loam from the marlstone of the lower oölite near Dursley, in Gloucestershire. In this case they found that one cubic yard of soil would cleanse at least 9.9 gallons in twenty-four hours, which is equivalent to the cleansing of nearly 100,000 gallons of sewage per day for every acre, provided that the grounds were underdrained at the depth of six feet. A light sand of bright red color from the new red sandstone at Hambrook, in Gloucestershire, purified satisfactorily only 4.4 gallons of London sewage per cubic yard during the twenty-four hours. A sample of peat from Lancashire worked rather poorly, although it seemed probable that, after use for some time, the peat would purify about four gallons per cubic yard per twenty-four hours.

It would seem that almost any porous and finely-divided soil will serve for the purification of sewage, the amount purified in a given time depending upon the nature of the soil. It is, however, evident that the process is not simply mechanical but that chemical action is concerned in it. The question very naturally presents itself, whether in conducting the process on the large scale the pores of the soil will not ultimately become clogged so that the filter will cease to act. It is possible that this might happen after a long time, if the

sewage contained a large quantity of suspended matter. If the sewage be allowed to settle or if the suspended matters be removed by the treatment with lime, or with lime and clay, it is probable that the duration of the efficiency of the filter would be practically unlimited.

The cleansing property of natural soil, which has been just described, may be taken advantage of for the purification of sewage according to one of two systems. When the sewage is supplied to a limited area of land in quantities approaching the maximum which can be cleansed by that amount of land, the process is known as "intermittent downward filtration." This process aims at the *purification* of the sewage and may without hesitation be pronounced successful. The climate of England is such that the process may be carried on even in winter, and the temperature of the sewage, as it comes from the towns, prevents the liquid from freezing. As the most extensive and best example of "intermittent filtration" is carried out in connection with sewage irrigation, its description will appropriately follow that of the irrigation process, which is the second method of taking advantage of the cleansing properties of natural soil. In this method, the sewage is applied over a large area, and while, if the land be properly underdrained and the sewage properly distributed, the organic matters of the sewage are in great measure destroyed and the nitrogen which is not taken up by plants escapes as nitrites or nitrates, yet what is aimed at is not so much this oxidation of the ammonia and the nitrogenous organic matter, as the appropriation of the fertilizing ingredients by the growing crops. As far as the furnishing of a purified effluent water is concerned, the process is a success: that *under proper management*, the use of sewage in irrigation may be made to repay, to a greater or less extent, the expense attending its purification, there is no doubt. The opinion of the Committee of the British Association as well as that of the Rivers Commission, is that the true solution of the sewage difficulty is in its employment for purposes of irrigation. The analyses of a great number of samples of effluent water from the various sewage-farms gave, in nearly every case, satisfactory results, while, say the Commissioners :—

"On the other hand, we have never taken a sample of effluent sewage that had been subjected on a working scale to any other cleansing process, which was not still so highly charged with putrescible animal matters as to be utterly unfit for admission into running water. Irrigation is the only process of cleansing sewage which has stood the test of experience, and unless it be extensively adopted, there is but little hope of any substantial improvement in our sewage-polluted rivers. * * * * * We have no hesitation in recommending irrigation as the only plan of dealing with the sewage difficulty at present known to us, which at once abates a nuisance and turns to profitable account an otherwise valueless material."

These quotations are not to be understood as unfavorable toward intermittent filtration as a means of simply purifying sewage: the success of this process on a large scale had not been fully established at the date of the report quoted.

Sewage irrigation has many opponents, and many ill-managed sewage-farms give reasonable cause for criticism. Several things are necessary for the successful conduct of sewage farming, which does *not* consist in flooding low or undrained land with sewage, allowing it to run from the surface of the land unpurified and having contributed to the growth only of a coarse, rank grass. The ground must be properly laid out, the sewage supplied methodically and according to the needs of the growing crop; above all, there must be a directing mind, for a sewage-farm will not take care of itself. Thus conducted, the farm need not be a nuisance, the sewage will be purified and the crops increased in amount without deterioration in quality.

Sewage irrigation is no novelty. In Italy, in the neighborhood of Milan, sewage has long been used for purposes of irrigation, and the Craigentinny meadows, in the neighborhood of Edinburgh, have been treated with sewage for many years. At Milan the liquid refuse of the city is collected in large sewers which join one another and meet in a canal called the "Vettabbia." This is made to ramify and serve for the irrigation of about 4,000 acres of land, after which it falls into the river Lambro, about ten miles below the city. The amount of sewage supplied to the land is at about the rate of the liquid refuse of forty persons to the acre. The land irrigated with sewage is devoted mainly to the cultivation of grass, and the crops are superior to those raised upon neighboring lands which are irrigated with water simply. The

severity of the winters is not such as to prevent the application of sewage; in fact, the somewhat elevated temperature of the sewage as it comes from the town protects from frost the fields to which it is applied.

The meadows near Edinburgh, although often cited as an example, do not afford a fair example of sewage irrigation as a means of purifying sewage. Here the liquid refuse from a population of 100,000 persons is distributed over about 400 acres only. The area is not sufficient to take up the whole of the filth brought down by the water and as a result, the sewage is very imperfectly purified, while large crops of a rather coarse grass are obtained.

A good example of a well-conducted sewage-farm is Breton's farm,* at Romford, near London. Romford is a town of 8,000 inhabitants: the refuse of about 7,000 people is discharged into the sewers and the dry-weather flow is about 250,000 gallons per day. The average composition of the sewage was (Sept. 3 and 4, 1869), in 100,000 parts:—

Solid matter in solution, ...	98.5
Suspended matter, ...	19.75
Ammonia, ...	1.2
"Albuminoid Ammonia,"	1.0
Chlorine, ...	14.5

The sewage is thus seen to be weak as compared with London sewage or with the "average" of the Rivers Commission. (See Table I.)

We visited Romford on the 13th of August, 1872: the farm comprises about 125 acres, mostly laid out in beds in the ridge and furrow system: the soil is light and sandy with a gravelly subsoil. A portion of the farm is underdrained at a depth of five or six feet. The sewage is brought from the town in iron pipes and received in storage tanks: it is thence pumped up into the carriers, which are in part painted sheet-iron troughs and in part concrete conduits. Although the day was warm there was no offensive smell either from the

* An account of a visit made to "Breton's Farm" in 1870, by the Chairman of the State Board of Health may be found in the Second Annual Report of the Board, page 241.

tanks or from the open carriers. The sewage in the tanks is covered with a thick, black scum, under which the sewage flows into and from the tanks. This scum prevents the odor of the sewage from being perceived, but when it has increased so that its removal becomes necessary, it is stated that the operation is attended by a fearful stench.

A great variety of crops are cultivated,—Italian rye-grass, cabbages, potatoes, turnips, peas, beans, Indian corn, etc. The vegetables grow luxuriantly (and the weeds as well); cabbages of good size and appearance grew on what was a mere gravel-pit, and a very promising crop of onions was receiving the sewage at the time of our visit. The lessee of the farm pays the town of Romford £600 per annum for the sewage pumped up into the troughs.

This farm is taken for description partly because for several years the Sewage Committee of the British Association have here carried on a series of experiments, an account of which appears in the annual reports of the Association.

A difficulty which attends the use of sewage for irrigation is the necessity of providing for its reception under all conditions of its flow, night and day, summer and winter, in dry weather and in times of storm. This difficulty is met at Romford by storing the sewage in tanks, where most of the suspended matters are deposited. This deposition of the suspended matters is a positive advantage but their subsequent removal from the tanks would create an intolerable nuisance in any inhabited locality. To obviate this nuisance and to afford a means of disposing of the sewage-sludge,—a disagreeable mixture, of little agricultural value,—a method of treating sewage has recently been proposed by Gen. H. Y. D. Scott. He adds to the sewage a mixture of lime and clay, allows the flocculent precipitate which is formed to subside, dries the sludge and burns it in kilns. This process of treatment is carried on at Ealing, near London. (The sewage, however, is not used for irrigation, but after this treatment is run directly into the river.) The product of the calcination is virtually "Portland cement," which is the "strongest cement known and which is made by thoroughly incorporating, by mixture with a large body of water, chalk or lime and clay in the proportion of two parts of *quicklime* to one

part of clay: the compound is allowed to settle in large tanks, the mixture dried on hot plates and then calcined at a high temperature; the burnt material is then ground to a fine powder."

Gen. Scott states that "when the mixture of lime and clay is added to sewage water, a precipitate rapidly subsides, carrying with it all the suspended mineral and organic matters together with a considerable portion of such matters as exist in the sewage in a state of solution. The organic matter carried down generally amounts to one-third or one-fourth of the whole, and supplies almost a sufficiency of fuel for the calcination of the lime and clay, even to the point at which Portland cement is produced. It is only necessary to set the dried mixture fairly alight and it will burn freely."

We witnessed this process of treating sewage as it is carried on at Ealing. As a means for the complete purification of sewage it is insufficient, no chemical analysis being necessary to prove the impure condition of the effluent water; as a means of getting rid of the sewage sludge it seemed valuable. The drying of the sludge was attended by no very perceptible odor, and it is stated that the deposit will stand for months without giving off any disagreeable smell. The deposit differs in this respect from that produced by the addition of lime alone; the presence of the larger amount of earthy matter, preventing in a measure the tendency to putrefy.

Gen. Scott prefers to add the mixture to the sewers in the town, since "the precipitate formed exercises a scouring action and the decomposing slimy matter usually found adhering to the bottom and sides of the drains is entirely got rid of, and the sewage arriving at the outfall is really fresh sewage, which is, as is well-known, free from the deleterious influences of that which is undergoing decomposition." Specimens of pebbles from the drains of the town bear out this statement.

The cement produced in this way is really a good cement, but the claims of the process to consideration are based upon the fact of its affording the means of getting rid of the less valuable part of the sewage—the suspended matters. In districts where lime is applied by farmers directly to the land, it has been proposed to modify this process by precipitating

with milk of lime without the addition of clay, calcining the deposit when dry, and applying it, after reburning, to the land. By this means the amount of phosphates in the lime is increased, and the lime would be worth somewhat more, agriculturally, than in its natural state; it is doubtful, however, whether it would really be worth more than the wet sludge; it would certainly be more readily handled.

The difficulty of the irregular supply of sewage is also met by combining the two systems of irrigation and intermittent filtration,—that is, by laying out certain filtering areas on to which the sewage may be run when not needed for irrigation. This double system is carried out at Merthyr Tydfil in Wales, where the land has been laid out under the direction of J. Bailey Denton, C. E.

The population of the district of Merthyr Tydfil is about 50,000, but many of the dwellings are not connected with the sewers, and the sewage, which in dry weather averages 900,000 gallons per day, is very dilute. To purify this amount of sewage an area of twenty acres is laid out in beds of five acres each, to each of which the sewage is applied for six hours continuously. The soil is a fine, deep, friable loam, and is underdrained at a depth of six or seven feet at interval of about forty yards. The drains run underneath the roads, so that the sewage cannot pass directly into them with the risk of imperfect filtration. While the filtering areas were in process of construction the sewage was distributed over two beds only, of five acres each. Each bed received the sewage for twelve hours and the effluent water was satisfactorily pure.

Connected with the filtering areas are portions of land on which the sewage is used for purposes of irrigation, but on the filter-beds themselves, contrary to what might be expected, it has been found possible to raise good crops. When not under rye-grass, the land is thrown into ridges and furrows, and on the crests of the ridges, three feet apart, the vegetables are planted and are thus elevated above the sewage which is run into the furrows between them.

The sewage before being distributed over the filtering areas is treated with lime, and caused to pass through a rough filter made of crushed slag. The separated matter is not very

readily disposed of, but might perhaps be burned, as suggested by Gen. Scott. The clarified sewage, when applied to the land, although in such large quantities, gives rise to no offensive odors, even in the hottest summer-weather.

For cases where it is proposed to adopt "intermittent filtration" *per se*, that is, not in connection with irrigation, in order to secure permanence of effect and a profitable return, and to prevent the possibility of nuisance, Mr. Denton proposes: first, that instead of using only one series of filtering areas (consisting of the four plots necessary for daily use), three series of an equal extent should be prepared for use, each of itself capable of cleansing the sewage, and, by special preparation, of growing crops at the same time; second, that each series should be used for purification for a year only at a time so that two out of the three series may be devoted to plant-growth. In this way a very great return per acre may be obtained from the two series not in use for filtration, for they receive only that amount of sewage which will produce the most abundant yield.

The amount of land necessary for purifying the sewage of any given town, would vary very much according to the nature of the soil and the strength of the sewage. With soil of good quality underdrained at a depth of six feet, "average sewage" should be purified at the rate of 3,300 persons to the acre, but the purification would be rendered permanently secure by laying out three series of beds as above suggested, in which case each acre would be supplied on the average with the sewage of 1,100 persons.

Objections have been made to the application of sewage to growing crops, not only from the idea that such application may give rise to offensive odors, but also on the ground that portions of the sewage may become attached to the stalks of the grass and to the vegetables, making them unwholesome as food, and even the means of propagating certain parasitic diseases. These charges can be completely disproved only by a large experience, but the weight of evidence tends to show that such fears are groundless. Cattle fed exclusively on sewaged crops for long periods, and then slaughtered, have been found entirely free from parasitic disease.

On the Treatment and Utilization of Sewage in Massachusetts.

By the preceding review of the aspect of the sewage question in England, we reached the conclusion that, up to the present time, there has been no way devised of satisfactorily purifying sewage, except by filtering it intermittently through natural soil; we have also seen that, under favorable conditions, this filtration may be so conducted as to utilize in irrigation the fertilizing ingredients of the sewage. As we turn now to examine the conditions which exist in our own State, it will not be at all necessary to consider the various plans, which have been tried abroad and found wanting. The question will be simply, Can we purify our sewage by the means which have been found to answer in England, and is there hope that a return greater than the outlay involved may be obtained by such a disposal of the liquid refuse of our towns?

The only cities as yet provided with anything like a comprehensive sewerage system are Boston and Worcester; several other of the larger towns have the beginnings of such a system, and the introduction in many others of a general water-supply, will lead to the adoption of some system of sewerage. To our minds, the question with reference to the inland towns, to the towns situated, like Worcester, on running streams, presents itself in a different aspect from that offered by sea-ports like Boston. We propose, therefore, first to consider the character of the sewage of Boston, and inquire into the necessity of a different disposal from that which is now made of it.

Boston affords unusual facilities for the discharge of the sewage into tide-water: there are, in fact, forty or more localities where the sewers discharge themselves between high and low water mark. The city is provided very generally with water-closets, yet, during the year 1871, there were removed 5,000 cords of night-soil from privies within the city limits, besides 10,000 cords of street-sweepings and cess-pool matter. The storm-water finds its way into the sewers, there being catch-pits to intercept the heavier portions of the street-wash, and the contents of these cess-pools, as well as the solid sewage-matter which accumulates in the man-holes,

are from time to time removed. The sewers are all comparatively short, the sewage does not remain in them long enough to become offensive, and the sewers are, as a general rule, kept clean, owing to the abundant supply of water, and to the fact that rain-water is discharged into them.

It may be remarked in passing, that the material above alluded to as being removed from the man-holes, although black and rich looking, has in reality very little value. A sample taken, October 30, from the corner of Brookline and Tremont Streets, dried at 100° C., even after removing the pebbles which would not pass through a sieve of twenty meshes to the linear inch, lost only 4.1 per cent. on ignition; the percentage of nitrogen in the dry material was only 0.0126, and the silicious matter insoluble in acid amounted to 88.10 per cent.

The present system of Boston sewerage may be regarded both in its sanitary and economical relations. In the first place, it is of the utmost importance, in so far as public health is concerned, to be absolutely *rid* of the sewage. Our population is dense, and we cannot afford to retain these foul materials among us. Whether there be more or less money value in the water flowing from our sewers; whether in each ton of such water there be one, two or three cents' worth of a fertilizer, which may or may not be extracted and saved by chemical or other processes, is of comparatively little account. The health of the city has a positive and appreciable money value. Health is truly wealth. We think no better bargain can be made at the present time, than to deliver the sewage in strong tidal currents. It is now but partially dispersed: a large portion of the insoluble contents of the sewers is deposited in the docks or on the mud flats of Charles River. If this could be conducted to deep water, where it would meet a strong ebb-tide, by sewers extending to the ends of the wharves, or in the case of Charles River, by a capacious collecting sewer, reaching as far as the Charlestown bridges, it would be of great public advantage.

It is asserted that the discharge of the sewage into tide-water, contributes to the shoaling of the harbor. These objections are unfounded: it is true, that a deposit takes place in the docks into which the sewers empty, and neces-

sitates occasional dredging; as regards its influence on the harbor, the Harbor Commissioners "find no proof whatever of injury from the discharge of sewage. It is effectually and completely dispersed, and no trace of it is found in any bars or shoals outside of the docks and wharves."

On economical grounds, objection is made to the emptying into the sea of so much valuable fertilizing matter which should be returned to the land. It will be of interest in this connection, to endeavor to estimate roughly the value of Boston sewage.

The value assigned by English authorities to the solid and fluid excreta of the average individual of a mixed population, has already been stated to lie between $1.60 and $2.00 per annum: calculating from the same data, but taking into account the present price of different natural and artificial fertilizers, we shall feel inclined to set the value at about $2.75. The population of Boston in 1870 was 250,513: supposing that all the excretal matter found its way to the sewers, they would discharge annually, fertilizing material to the amount of $690,000. It has already been stated, that a considerable portion of the houses are not provided with water-closets, so that perhaps one-half of the excreta of the city is not discharged directly into the sewers. Therefore, the amount just stated far exceeds the value of the refuse matter from human sources. It is, to be sure, true that other refuse matters find their way into the sewers; some of these matters are, no doubt, of value, as the manure washed from the streets, and soap-suds and sink-wash; still, the amount stated above ($690,000) must be very much too large as a statement of the worth of what is valuable in the sewage at present. Taking also into account that even when privies are in use, a considerable part of the liquid refuse enters the sewers, we shall probably be safe if we diminish the above amount by one-third, and consider as the approximate annual value of the present sewage of Boston, the sum of $460,000.

Now in what state does the valuable matter of the sewage find its way into the sea? The amount of water used in the city during the year 1870–71, averaged about 15,000,000 gallons daily, or say 5,500 million gallons, or 23,000,000 tons annually. This amount of water enters the sewers increased

somewhat in amount, so that we may consider the annual amount of sewage as 25,000,000 tons, independent of the amount of water due to the rain-fall. If we consider simply this as the amount of dry-weather sewage, we have fertilizing material worth $460,000, diluted to 25,000,000 tons of liquid, and each ton will be worth 1.84 cents. If, however, we take into account the fact that the annual rain-fall of Boston is over fifty inches, and that fifty inches of rain-fall over 10,000 acres would amount to 56,500,000 tons, we see that the average value of the sewage must be very much lowered. If we suppose that three-fifths* of the rain-fall enters the sewers, we should have the value of the sewage reduced from 1.84 cents per ton to seventy-eight hundredths of one cent.

This statement is, of course, a very general one. We have also attempted to ascertain something of the value of Boston sewage from analytical examination of a number of samples kindly furnished us by Mr. W. H. Bradley, superintendent of sewers. The samples examined were taken under a considerable variety of conditions, at various hours of the day, and on various days of the week. The results are expressed in the following tables.

These results, which are brought into Tables II. and III., are thus separated for the reason that the specimens of Table II. were taken under such conditions that they can hardly be regarded as normal sewage; the large amount of chlorine found in most of them shows that there must have been a greater or less admixture with sea-water :—

* The area of the city, according to the Auditor's report for 1869–70, is as follows :—

Original area of uplands in Boston proper,	690 acres.
Area added and in process of filling,	880 "
of South Boston,	900 "
of East Boston,	800 "
of Roxbury,	2,184 "
of Dorchester,	4,533 "
Total area of Boston,	9,987 acres.

Of this territory, the portion unprovided with sewers includes a part of the Back Bay lands, one-quarter of South Boston, one-half of East Boston, one-half of Roxbury and all of Dorchester.

It is to be said that a portion of the rain-fall which eventually enters the sewers, does so indirectly, sinking through the ground and then entering through the walls of the sewers, so that even if the storm-water were excluded from the sewers, the 25,000,000 tons mentioned above would be still somewhat diluted by the rain-fall.

TABLE II.—*Examination of Boston Sewage.* (Results expressed in Parts per 100,000.)

Number.	DATE.	Solid Residue of— Filtered Sewage.	Solid Residue of— Unfiltered Sewage.	Suspended Matters by Difference.	Ammonia.	Albuminoid Ammonia.	Phosphoric Acid.	Chlorine.	Locality.
1	Tuesday, June 18, 4.00, P. M., .	177.40	–	–	3.400	0.230	0.080	71.5	Berkeley Street.*
2	Friday, " 21, 7.00, A. M., .	445.90	–	–	0.406	0.372	0.408	57.8	Concord Street.†
3	" " 21, 7.00, A. M., .	551.37	–	–	9.460	0.640	2.570	250.7	Albany Street.‡
4	Monday, " 24, early, . .	2,049.02	–	–	0.704	0.738	1.514	968.5	Central Wharf.§
24	Friday, July 27, 8.45, A. M., .	392.30	398.30	6.00	2.380	0.680	1.240	180.0	Harvard, cor. Albany Street.
30	Tuesday, Aug. 6, 3.25, P. M., .	261.00	318.00	57.00	–	0.850	4.160	101.0	Broad, cor. Congress Street.
31	Friday, " 9, 12.10, P. M., .	234.50	417.50	182.50	4.488	0.578	3.120	20.0	Pearl, cor. Purchase Street.
32	" " 9, 11.50, A. M., .	3,284.50	3,307.00	22.50	–	0.340	Trace.	1,354.0	Broad, cor. Belcher Lane.
33	" " 9, 11.30, A. M., .	188.00	204.50	16.50	–	0.408	1.960	89.0	Clinton, cor. Commercial Street.
34	Monday, " 12, 1.40, P. M., .	1,265.20	1,308.00	42.80	–	0.476	2.200	570.0	Richmond, cor. Commercial Street.
38	Thursday, " 15, 3.25, P. M., .	186.00	228.10	42.10	3.400	0.442	1.880	80.0	Clark, cor. Commercial Street.
41	Tuesday, Sept. 3, 9.20, A. M., .	647.00	662.50	15.50	1.734	0.068	1.160	284.0	Warren Bridge, cor. Causeway St.
42	" " 3, 9.10, A. M., .	420.90	445.00	24.10	2.890	0.170	1.400	186.0	Canal Street, cor. Causeway Street.
47	Monday, " 9, ...	–	2,862.00	–	0.210	0.100	–	1,360.0	Broad Street, cor. Belcher Lane.
48	" " 9, ...	85.50	156.00	70.50	3.060	0.500	–	33.0	Clinton Street, cor. Commercial St.
49	" " 9, ...	406.50	482.50	76.00	3.600	0.775	–	192.0	Richmond St., cor. Commercial St.

* Mineral suspended matter, 6.99; Organic, ——.
† " " " 1.180; " 1.140.
‡ Mineral suspended matter, 0.835; Organic, 1.165.
§ " " " 4.890; " 16.280.

TABLE III.—*Examination of Boston Sewage.* (Results expressed in Parts per 100,000.)

Number.	DATE.		Solid Residue of— Filtered Sewage.	Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Phosphoric Acid.	Chlorine.	Locality.
5	Monday,	June 14, early, . .	180.60	–	–	5.429	1.018	2.220	75.8	Cambridge Street.*
10	"	July 1, " . .	49.00	64.00	15.00	–	–	–	11.5	Washington Street, Roxbury.
11	"	" 1, " . .	58.00	98.50	40.50	3.600	0.782	1.072	16.0	Tremont, corner Concord Street.
12	"	" 1, " . .	57.50	72.00	14.50	3.366	3.128	1.151	15.0	Dedham, corner Washington Street.
13	"	" 1, " . .	44.80	80.00	35.20	3.400	2.652	0.880	9.5	Union Park.
18	Tuesday,	" 9, 8.45, A. M., .	42.00	64.70	22.70	3.200	1.360	2.160	12.0	Dedham, corner Tremont Street.
19	"	" 9, 9.10, A. M., .	63.00	77.50	14.40	1.360	1.460	1.880	18.0	Union Park.
20	"	" 9, 9.30, A. M., .	78.00	94.50	16.50	1.904	0.544	2.640	29.0	Dover, corner Washington Street.
21	Wednesday,	" 10, 8.00, A. M., .	48.50	61.00	12.50	1.292	0.340	2.240	17.0	Union Park.
22	"	" 10, 8.10, A. M., .	35.00	54.00	19.00	2.210	0.884	1.800	8.0	Davis Street.
23	"	" 10, 8.30, A. M., .	38.00	60.20	22.20	1.564	0.748	1.960	12.0	Church, corner Tremont Street.
25	Friday,	" 26, 9.00, A. M., .	68.50	92.30	23.80	2.856	1.020	2.800	25.0	Beach, corner Kingston Street.
26	"	" 26, 1.45, P. M., .	53.50	105.00	51.50	0.348	0.348	0.840	15.0	Dudley Street.
27	"	" 26, 2.30, P. M., .	59.50	65.50	6.00	0.540	0.408	0.840	14.0	Beach, corner Kingston Street.
28	"	" 26, 3.00, P. M., .	43.00	72.80	29.80	2.040	0.747	1.200	11.0	Summer, corner South Street.
29	Tuesday,	Aug. 6, 3.15, P. M., .	73.50	87.80	14.30	2.720	0.918	1.880	23.0	Summer, corner South Street.

35	Monday,	Aug. 12, 1.45, P. M., .	54.60	94.80	40.20	2.550	0.510	1.920	12.0	Fleet, corner North Street.
36	Wednesday,	" 14, 7.30, P. M., .	74.00	129.50	55.50	0.680	0.340	1.880	26.0	Concord, corner Harrison Avenue.†
37	"	" 14, 7.45, P. M., .	109.70	133.50	23.80	0.238	0.340	2.120	43.0	Union Park.†
39	Thursday, .	" 15, 3.35, P. M., .	62.50	95.30	32.80	2.210	0.340	2.000	10.0	Battery, corner Commercial Street.
40	"	" 15, 3.45, P. M., .	103.50	134.50	31.00	0.340	0.272	0.840	28.0	Causeway Street.
43	Tuesday, .	Sept. 3, 9.00, A. M., .	–	–	–	4.488	0.408	2.000	27.0	Lowell, corner Minot Street.
89	Wednesday,	Oct. 30, . . .	46.80	60.20	13.40	4.200	0.600	–	14.0	Brookline, corner Tremont Street.
90	"	" 30, . . .	44.30	67.30	23.00	4.000	0.650	–	14.0	" " " "
91	"	" 30, . . .	49.50	65.50	16.00	5.000	0.600	–	14.0	" " " "
92	"	" 30, . . .	48.50	65.70	17.20	5.000	0.600	–	14.0	" " " "

* Mineral suspended matter, 8.08; Organic suspended matter, 20.76. Total, 28.84.

† Light rain; just after a heavy thunder shower.

Explanation of the Tables.—In these tables, the results are expressed in parts in 100,000. The number of pounds per ton may be found by multiplying by two and moving the decimal point two places to the left.

As the sewage is filtered with some difficulty, and the suspended matters cannot be thoroughly washed in any reasonable time, it has been thought best to evaporate separate portions, one portion filtered and the other unfiltered, and thus to determine the suspended matters by difference.

The "ammonia" represents the amount of ammonia given off when the sewage is distilled with carbonate of soda, and includes that existing in the liquid as ammonia, or its salts, and also, that coming from the decomposition of any urea present.* The residue from this distillation was treated with alkaline permanganate of potash, and the ammonia produced by the action of this agent on the albuminous matters of the sewage, gives an amount of ammonia as indicated under the head of "albuminoid ammonia." The amount of ammonia given off by various nitrogenous bodies under this treatment is different, although very constant in each particular case. In a mixture of the nature of sewage, the amount of nitrogenous organic matter may be somewhat closely approximated by multiplying the amount of "albuminoid ammonia" by ten.

The ammonia was, except in a few cases, determined by the use of Nessler's reagent. The phosphoric acid was determined in the *unfiltered* sewage: the other determinations were made in the filtered sewage.

After the examinations recorded in Tables II. and III. had been made, it was thought best to confine our further investigations, to samples taken from a single sewer, but taken at different hours of the day and night. The sewer chosen was the Summer Street sewer. The amount of territory drained by this sewer, before reaching the point at which the samples were taken, is stated by Mr. Bradley to be as follows :—

* We do not feel confident as yet, in asserting the presence or absence of undecomposed urea in the sewage; we have satisfied ourselves, however, that if any is present, it is decomposed by this treatment with carbonate of soda.

Private enclosures, . . .	583,000	square feet.
Public enclosures (Common, Cemetery, State House, &c.), . .	122,000	" "
Streets, ...	267,000	" "
Total, ...	972,000	square feet.

The territory drained contains public buildings, dwelling-houses and stores. The results of the examinations are expressed in Table IV.

TABLE IV.—*Examination of Boston Sewage, Summer Street Sewer.* (Results expressed in Parts per 100,000.)

Number.	DATE.	Solid Residue of— Filtered Sewage.	Solid Residue of— Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Nitrogen as Nitrites and Nitrates.	Chlorine.	Remarks.
50	Wednesday, Sept. 18, 10.00, A. M.,	60.00	93.50	33.50	3·00	0.50	0.005	24.0	Equal amounts of Nos. 50, 51, 53, 54, gave 0.4094 parts phosphoric acid.
51	" " 18, 12.00, M.,	71.00	96.00	25.00	4.00	0.70	*	23.2	It began to rain on Sept. 18, at 1.45 P. M.
52	" " 18, 2.00, P. M.,	41.80	424.50	382.70	2.00	0.30	0.012	14.4	0.0447 Phosphoric acid.
53	" " 18, 4.00, P. M.,	44.50	73.80	29.30	4.10	0.45	–	16.0	The rain ceased before 4, P. M.
54	" " 18, 6.00, P. M.,	68.00	89.00	21.00	4.50	0.55	–	21.6	– –
55	Monday, " 23, 6.00, A. M.,	85.50	115.30	29.80	3.00	0.50	0.081	36.0	– –
56	Wednesday, Oct. 2, 7.30, A. M.,	95.20	143.40	48.20	4.90	0.55	0.042	42.0	– –
57	" " 2, 9.30, A. M.,	78.60	126.00	47.40	5.10	0.50	–	33.0	– –
58	" " 2, 11.30, A. M.,	48.60	80.20	31.60	5.40	0.63	0.042	16.0	– –
59	" " 2, 1.30, P. M.,	47.50	70.80	23.30	5.70	0.63	0.062	16.0	– –
60	" " 2, 3.30, P. M.,	49.60	85.60	36.00	5.00	0.55	0.059	13.0	– –
61	Saturday, " 12, 8.00, P. M.,	27 50	28.20	0.70	2.00	0.42	0.021	9.0	– –
62	" " 12, 10.00, P. M.,	20.70	45.60	24.90	2.50	0.38	0.017	5.0	– –
63	" " 12, 12.00, P. M.,	18.30	23.10	4.80	1.80	0.22	0.009	5.0	– –
64	Sunday, " 13, 2.00, A. M.,	16.50	–	–	0.75	0.20	0.043	4.0	– –

65	Sunday, Oct. 13, 4.00, A. M.,	12.60	14.60	2.00	0.28	0.13	0.050	4.0	–	–
76	" " 13, 6.00, A. M.,	13.50	13.80	0.30	0.25	0.17	0.025	3.2	–	–
	Average of 33 day samples, . .	58.96	96.30	37.34	2.72	0.73	–	18.94	1.69 Phosphoric acid. Mean of 19 samples.	
	Average of 4 night samples, .	17.00	27.7	7.9	1.33	0.23	–	4.50	–	–

* Considerable.

Note.—It will be noticed in this and the following tables, that in many of the samples of sewage we have determined the amount of nitrogen, existing as nitrates or nitrites. These determinations are of interest because our experience, in this respect, differs from that of the English authorities who say that the sewage contains no nitrogen in this form. We find that whether the sewage be allowed to remain in stoppered bottles, or be exposed to the air, the amount of nitrates (or nitrites) increases quite rapidly. The amount of nitrogen existing in this form was determined by the modified aluminum process.

In endeavoring to express in some sense the average composition of the sewage, we have preferred to exclude those samples taken from the lower part of the city, where sugar-refineries and other manufactories are situated, for the reason that any scheme for the treatment of the sewage would probably involve special arrangements with reference to the waste from such sources. The Summer Street sewer may be regarded as standing midway, as far the sewage is concerned, between the thickly settled North End, and the less thickly inhabited districts of the South End: the results of the examination of the sewage of this locality are particular important.

If we refer to Tables II. and III., we see that, as a rule, the sewage is much weaker than the "average sewage" of the Rivers Commission (see Table I.). Taking the ammonia as an index, their average sample contains 5.557 parts in 100,000, and the minimum amount found in any sample from water-closet towns was 2.030 parts. In the Boston sewage, on the contrary, the largest amount found upon any one occasion was 5.70 parts, and the amount as a rule was very much less. The average of thirty-three day samples shows 2.725 parts of ammonia, and the average of the four night samples shows 1.330 parts: these statements are presented in tabular form as follows:—

Ammonia in parts per 100,000.

Rivers Commission average,	5.557
Maximum in samples from midden towns,	0.380
Minimum,	30.350
Maximum in samples from water-closet towns,	25.960
Minimum,	2.030
Boston sewage, average of thirty-three day samples,	2.725
Boston sewage, average of four night samples,	1.330
Maximum,	5.700
Minimum of day samples,	0.210

We should expect that the sewage of Boston, would be weaker than that of English towns and cities, from the fact that the water-supply is used much more lavishly in household operations.

If we accept the averages in Table IV. as actually representing the average composition of Boston sewage in ordinary weather, what value shall we assign to it?

Gaugings made by the Cochituate Water Board at various times, would seem to justify us in stating the average hourly consumption of water by night, to be about one-third that by day. Making allowances for this fact, and taking the above averages as a basis of calculation, we should say that the value of the sewage was about 1.88 cents per ton.*

It is to be noted, that in making up the averages, most of the samples were of dry-weather sewage, so that this value is far too large, if we take into account the rain-water which finds its way to the sewers. Compare, for instance, Nos. 51 and 52. The marked decrease in the strength of the sewage in the second instance, is due to the fact that a heavy shower occurred shortly before the taking of No. 52; the shower had subsided before No. 53 was taken.

Of all the day samples thus far examined, the one which contained the most ammonia would be worth 3.44 cents per ton; that containing the least ammonia would be worth 0.679 cent per ton.

Although the examination of a larger number of samples might lead to results which would alter somewhat the averages on which we have based our calculations, yet they are probably near enough to the truth to answer our present purpose. The average value of the sewage could hardly be more than one cent a ton, and although the aggregate value of the sewage seems great, there has as yet been devised no plan by which the money value could practically be recovered from it. Our own conclusions may be very well stated, in the words of the superintendent of sewers, as expressed in his Annual Report for 1871:—

"To utilize by irrigation the dry-weather sewage only of Boston, would require its collection by a large encircling sewer, the raising of 100,000 tons of water daily, to the height of twenty or thiry feet, the construction of a covered channel, sufficient for its carriage to a suitable district, and its continuous discharge upon a farm of 2,000 acres. What should be done with the

* There is no universally adopted method of estimating the value of the fertilizing ingredients of such a substance as sewage. In our calculations, we have reckoned the ammonia at 25 cents per lb., the "albuminoid ammonia" at 20 cents, and the phosphoric acid at 10 cents.

storm-water drainage (often the most valuable, but requiring ten times the provision necessary for dry weather)*; where to find the necessary farm within a reasonable distance, where land is not constantly growing in value for building sites; and what to do with the works during the four winter months, when the ground is frozen and the whole system inoperative, are questions that would precede any attempt to estimate the cost or the return from such a project."

Sewage of Worcester.—The admirable system of sewerage which Worcester possesses, has already been somewhat described; at present, the whole of the sewage entering the sewers is discharged into Mill Brook; eventually a small portion will be discharged on the other side of the city, into what is known as Beaver Brook. Mill River rises in the north-east part of Holden, and before reaching the city it drains an area of some 7.8 square miles, mostly farming country. Worcester has an abundant water-supply, the daily consumption being estimated to average 3,000,000 gallons. Many buildings which have no connection with the sewers are supplied with water, and the average dry-weather sewage is estimated at 1,500,000 gallons per day. (See Mr. Ball's Report in the Appendix.) Mill Brook having received this sewage in addition to the refuse of some manufacturing establishments, is about doubled in volume, and flowing below the city, joins the larger and purer Kettle Brook to form the Blackstone River. Our examination of the Blackstone River, as will appear subsequently, showed that as yet the amount of impurity carried in by Mill Brook is insufficient to very seriously interfere with the use of the river-water, except as a souce of water-supply; still it is to borne in mind that the sewage is increasing from year to year in amount and in strength, and a very dry season might even now cause the river to be offensive, as far down as at Blackstone. The day may not be in very remote future, when the legitimate use of the river in manufacturing operations may call for an injunction upon its use as a carrier of sewage. In such an event, would it be possible to purify the sewage, so that it might be

* Our examination would seem to show that in the case of Boston, the storm-sewage is very much weaker than the dry-weather sewage: the abundant use of water tends to keep the sewers clean, and to prevent the accumulation of organic matter to be washed away when the sewers are flushed by a heavy shower. The suspended matter in the storm samples consisted largely of street wash, containing a considerable proportion of sand, and being of little agricultural value.

run into the river without causing a nuisance? This question is one of greater interest, from the fact that Worcester is an example of an inland town, the liquid refuse of which must ultimately find its way to some water-course. Of such towns, there are many in our State, already furnishing themselves with a more or less complete system of water distribution, and a system of sewerage follows in natural order. The problem is, moreover, one which must soon press for solution upon the larger inland cities of other States.

In the case of Worcester, we do not hesitate to say, that a scheme for the treatment of the sewage is practicable. At the request of the Secretary of the Board, Mr. Phinehas Ball, civil engineer of Worcester, has prepared a statement of a plan which he has had in his own mind, by which the sewage may be collected and conveyed to a point below the city, where there is an abundance of land suitable for the arrangement of filtering beds on the large scale, or where the sewage might be employed for purposes of irrigation. But, of course, the question immediately suggests itself, what could be done during the winter months. In England it has been found possible to run the sewage upon fallow land throughout the winter; in fact, the temperature of the sewage itself is some degrees above the freezing point, and prevents the ground from freezing. In our climate there would, however, be some months, not more than four, in which it would hardly be possible to cleanse the sewage by filtration; during that time a less efficient means of purification might be adopted; namely, this: to the sewage at Worcester, add a quantity of lime and clay, as recommended by Gen. Scott (see p. 57), and allow the sewage to settle in basins at the point where the sewage is in summer run upon the land. The surface of the water in the settling-basins might be frozen over, but the sewage would enter beneath the ice, the flocculent sludge would settle, and the clarified liquid might then be discharged into the river. Although the sewage thus clarified would still be liable to putrefaction, the low temperature of the air and of the water would prevent the river from becoming offensive. The sludge might accumulate to a certain amount and then be removed, dried and burned to cement. There would probably be no difficulty in removing the sludge from

time to time, especially if the settling tanks were somewhat protected from the weather, for the temperature of the sewage is so much higher than that of the surrounding air, that Mill Brook, into which it is discharged, does not freeze in winter. It may further be said that it probably would be found advisable to treat the sewage with lime, or with lime and clay, throughout the summer as well, before running it upon the land.

Having thus shown that there is no insuperable obstacle in the way of the sufficient purification of the sewage of Worcester, the question arises, Could there be expected any return from the large outlay that would necessarily be involved? In this connection it is desirable to ascertain what is the approximate value of the Worcester sewage at present. To aid in in forming some estimate, we have analyzed a considerable number of samples of the liquid from the three most important sewers, the samples being taken systematically at stated hours. The sewage was collected under the direction of Mr. R. H. Chamberlain, superintendent of sewers. Weirs were introduced into the sewers and the flow of water at the time of sampling was in each case observed.

Of the sewers chosen, the Southbridge-street sewer receives the sewage of about 429 acres, occupied mostly with dwelling-houses. The Front-street sewer drains forty-four acres, compactly covered with stores and dwelling-houses in about equal proportion. The Thomas-street sewer drains a similar district of some twenty-five acres. The sewers receive subsoil water, but during the time the samples were taken, the cold weather kept the surface water very completely from the sewers, and these samples may be regarded as affording a fair average of the dry-weather sewage.

The results of the examination are given in the following table :—

TABLE V.—*Examination of Worcester Sewage.* (Results expressed in Parts per 100,000.)

Number.	DATE.	Flow in gallons per second.	SOLID RESIDUE OF— Filtered Sewage.	SOLID RESIDUE OF— Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Remarks.
	Southbridge-street Sewer.									
105	Wednesday, Nov. 20, 6, A. M.,	16.7	19.0	22.0	3.0	0.35	0.075	3.2	0.276	– –
106	" " 20, 9, A. M.,	17.3	22.5	30.0	7.5	1.00	0.225	3.6	0.284	– –
107	" " 20, 12, M., .	17.3	24.5	32.5	8.0	1.00	0.300	4.4	0.132	– –
108	" " 20, 6, P. M.,	16.7	22.8	34.1	11.3	0.65	0.250	3.2	0.255	– –
109	" " 20, 9, P. M.,	16.4	17.4	23.6	6.2	0.30	0.079	2.8	0.235	– –
110	" " 20, 12, P. M.,	15.4	18.8	21.0	2.2	0.25	0.075	2.8	0.227	– –
111	Tuesday, " 26, 6, A. M.,	14.2	6.7	10.0	3.3	0.50	0.075	2.2	0.225	– –
112	" " 26, 9, A. M.,	17.7	21.7	60.2	38.5	1.50	0.213	4.0	0.029	– –
113	" " 26, 12, M., .	17.7	17.5	40.8	33.3	1.00	0.125	3.6	0.032	– –
114	" " 26, 6, P. M.,	17.3	19.3	41.1	21.8	0.65	0.087	3.6	0.115	– –
115	" " 26, 9, P. M.,	15.7	7.5	11.5	4.0	0.48	0.077	2.4	0.143	–
116	" " 26, 12, P. M.,	14.8	18.2	21.2	3.0	0.30	0.062	2.8	0.338	– –
123	" Dec. 3, 6, A. M.,	14.2	18.2	25.9	7.7	0.95	0.070	2.8	0.383	0.0426 Phosphoric acid. Mean of 123, 127 and 128.
124	" " 3, 9, A. M.,	17.7	27.0	55.3	28.3	0.96	0.380	3.2	0.075	– –
125	" " 3, 12, M., .	18.0	26.0	51.8	25.8	0.80	0.213	4.0	0.048	– –
126	" " 3, 6, P. M.,	15.7	21.5	36.1	14.6	0.90	0.175	4.0	0.233	– –
127	" " 3, 9, P. M.,	15.4	18.1	22.4	4.3	0.53	0.050	3.2	0.315	– –
128	" " 3, 12, P. M.,	15.1	19.1	20.7	1.6	0.52	0.050	2.4	0.356	– –

TABLE V.—Concluded.

Number.	DATE.	Flow in gallons per second.	Solid Residue of— Filtered Sewage.	Solid Residue of— Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Remarks.
	Front-street Sewer.									
130	Saturday, Dec. 7, 6, A. M.,	2.5	15.3	16.8	1.5	0.95	0.150	2.4	–	0.1212 Phosphoric acid. Mean of 130, 134, 135.
131	" " 7, 9, A. M.,	2.8	20.1	43.5	23.4	2.50	0.400	3.6	–	0.3832 Phosphoric acid. Mean of 131, 132, 133.
132	" " 7, 12, M.,	3.2	20.1	30.5	10.4	2.00	0.260	4.0	–	– –
133	" " 7, 6, P. M.,	3.1	18.1	29.3	11.2	1.37	0.175	4.0	–	– –
134	" " 7, 9, P. M.,	2.8	14.2	18.0	3.8	0.95	0.120	2.4	–	– –
135	" " 7, 12, P. M.,	3.1	5.8	10.0	4.2	0.50	0.075	2.0	–	– –
136	Monday, " 9, 6, A. M.,	2.8	16.8	27.5	10.7	1.10	0.300	3.2	–	0.2086 Phosphoric acid. Mean of 136, 140, 141.
137	" " 9, 9, A. M.,	3.2	26.6	75.3	48.7	3.00	0.500	4.0	–	0.2726 Phosphoric acid. Mean of 137, 138, 139.
138	" " 9, 12, M.,	4.7	25.8	66.5	40.7	1.50	0.400	4.4	–	– –
139	" " 9, 6, P. M.,	3.2	18.0	30.5	12.5	1.56	0.300	4.0	–	– –
140	" " 9, 9, P. M..	3.1	12.9	15.1	2.2	0.75	0.300	2.0	–	– –
141	" " 9, 12, P. M.,	2.8	9.9	11.5	1.6	0.40	0.200	2.0	–	– –
142	Tuesday, " 10, 6, P. M.,	3.9	12.5	16.9	4.4	1.25	0.140	2.4	–	– –
143	" " 10, 9, P. M.,	3.2	13.5	13.8	0.3	0.75	0.088	3.6	–	– –
144	" " 10, 12, P. M.,	3.2	11.4	13.5	2.1	2.75	0.950	2.4	–	– –
145	Wednesday, " 11, 6, A. M.,	2.0	23.3	27.8	4.5	2.00	0.230	6.8	–	– –
146	" " 11, 9, A. M.,	3.9	60.6	125.5	64.9	3.50	0.800	6.4	–	1.637 Phosphoric acid.
147	" " 11, 12, M.,	4.0	15.7	21.2	5.5	1.80	0.200	3.2	–	– –

	Thomas-street Sewer.									
148	Monday, Dec. 16, 6, A. M.,	0.9	13.8	14.5	0.7	0.25	0.100	2.4	–	0.2046 Phosphoric acid. Mean of 148, 152, 153.
149	" " 16, 9, A. M.,	0.9	32.5	61.9	29.4	4.50	0.750	6.0	–	0.5586 Phosphoric acid. Mean of 149, 150, 151.
150	" " 16, 12, M., .	1.0	26.8	56.1	29.3	2.00	0.500	4.4	–	– –
151	" " 16, 6, P. M.,	0.8	23.7	31.0	7.3	2.15	0.300	4.8	–	– –
152	" " 16, 9, P. M.,	0.8	15.5	16.8	1.3	0.70	0.080	3.2	–	– –
153	" " 16, 12, P. M.,	0.5	16.0	17.2	1.2	0.33	0.062	2.4	–	– –
154	Tuesday, " 17, 6, A. M.,	0.8	14.2	16.9	2.7	0.40	0.045	10.8*	–	0.2046 Phosphoric acid. Mean of 154, 158, 159.
155	" " 17, 9, A. M.,	0.8	25.7	62.3	36.6	3.50	0.400	4.8	–	0.4306 Phosphoric acid. Mean of 155, 156, 117.
156	" " 17, 12, M., .	1.0	33.1	52.8	19.7	2.00	0.350	2.4	–	– –
157	" " 17, 6, P. M.,	0.8	51.6	53.9	2.3	1.50	0.163	23.2*	–	– –
158	" " 17, 9, P. M.,	0.8	23.1	25.5	2.4	1.50	0.163	7.6	–	– –
159	" " 17, 12, P. M.,	0.5	20.2	23.8	3.6	0.63	0.070	4.4	–	– –
160	Wednesday, " 18, 6, P. M.,	1.0	19.4	20.9	1.5	1.50	0.200	4.0	–	– –
161	" " 18, 9, P. M.,	0.8	18.2	21.2	2.9	1.88	0.150	3.6	–	– –
162	" " 18, 12, P. M.,	0.8	13.2	15 1	1.9	0.60	0.125	2.4	–	– –
163	Thursday, " 19, 6, A. M.,	0.8	12.4	14.3	1.9	0.50	0.075	2.0	–	– –
164	" " 19, 9, A. M.,	0.8	30.0	58.4	28.4	4.50	0.500	8.0	–	– –
165	" " 19, 12, M., .	0.8	21.4	27.4	6.0	2.05	0.225	4.4	–	– –
	Average of 27 samples, taken at 6, A. M., 9 and 12, P. M., .	–	15.29	–	–	0.745	0.144	3.1	–	0.1940 Phosphoric acid. Mean of 12 determinations.
	Average of 27 samples, taken at 9, A. M., 12, M., and 6, P. M.,	–	25.35	–	–	1.876	0.316	4.17	–	0.6564 Phosphoric acid. Mean of 13 determinations.

* These determinations are omitted in making up the averages as they are so abnormal.

For purposes of calculation we have divided the day into two parts, and have made two averages, one including the the samples taken at 6, A.M., 9 and 12, P.M., the other those taken at 9, A.M., 12, M., and 6, P.M. The averages thus calculated are introduced into the table. Reckoning the value of the sewage by the same standard as in the case of the Boston sewage, and taking into account that the flow from 9, P.M. to 6, A.M. is about eight-ninths of the flow from 9, A.M. to 6, P.M., we estimate the average value of the dry-weather sewage of Worcester to be 0.861 of a cent per ton.

It would not be possible to say how great a return could be derived from the use of such dilute sewage as this, if applied in irrigation. If the sewage were conveyed below the city to lands laid out for purposes of filtration, no doubt adjacent land might be laid out to receive portions of the sewage for application in irrigation; with the present price of labor, it is not probable that the return would equal more than a small fraction of the outlay, although the fact that the sewage could be delivered by gravitation would be a great advantage.

In regard to the amount of land which would be necessary for the purification of the sewage, it is impossible to make accurate estimates without first having made experiments upon the particular soil. It has been already stated that with soil of good quality and underdrained at a depth of six feet, the sewage of 3,300 persons to the acre may be satisfactorily purified. Worcester would thus require, if all the dwellings were connected with the sewers, an area of thirteen acres, at least. To purify the sewage by using it in irrigation would require as much probably as 1,000 acres.

For purposes of comparison we have introduced a table, comparing the average Worcester sewage with that received at various English sewage-farms, according to analyses of Dr. Letheby, made several years since.

TABLE VI.—Parts in 100,000.

DESCRIPTION.	Total dissolved matters.	Ammonia.	Albuminoid Ammonia.
Worcester, day average,	25.35	1.876	0.316
" night average,	15.29	0.745	0.144
Aldershot Farm,	77.04	10.77	1.34
Banbury "	69.81	5.44	0.40
Warwick "	67.44	3.14	0.20
Rugby "	52.38	6.33	0.23
Rugby "	61.86	5.49	0.17
Worthing "	43.33	0.34	0.11
Carlisle "	43.10	2.74	0.17
Croydon "	39.53	2.86	0.34
Norwood "	53.57	2.86	0.46

No really systematic and well-conducted efforts have, as far as we know, been made in this country to utilize sewage by irrigation. It was once attempted to distribute the sewage of the Lunatic Hospital at Worcester over some adjacent land, but there was no underdrainage, the system, such as it was, being once arranged, was left to take care of itself, and the result was understood to be unsatisfactory to all concerned.

The Effect of Sewage and Manufacturing Refuse on Running Streams.

One of the most important questions connected with the disposal of sewage-matter is the effect of draining the same into running streams. The brooks and rivers offer naturally a convenient means of disposing of such waste matters as will float down the stream, and of such as may be discharged, dissolved or suspended in water, from the surrounding territory. This is especially the case if, in accordance with the opinion expressed on previous pages, the water-supply furnishes, wherever applicable, the best means of removing the excreta and other refuse matters from the dwellings of the towns. The sewage must be disposed of somewhere, and is directed towards the nearest water-course. Nor is there wanting temptation to throw solid material into the rivers, or to allow it to accumulate on the banks, to be washed into the streams by freshets. Manufactories are located on river-

banks, partly for the sake of the water-power, partly on account of the desire to use the water in various manufacturing operations, and partly because the running stream affords an opportunity of readily disposing of the waste liquors and other refuse.

It is proposed by the State Board of Health, at a future time, to investigate more closely the nature and amount of the materials thrown into the various rivers of the Commonwealth from the manufactories on their banks, to see how far this pollution is unnecessary, and to suggest means for the preservation of the streams in a condition of as great purity as may be possible. For the purposes of this present Report, and as a preliminary to this proposed investigation, it was thought best to take a single stream, on which many factories were located, and to examine specimens of water taken from various points of its course. In order to draw perfectly satisfactory conclusions as to the amount of impurity turned into the river from towns and factories on its banks, it would be necessary to make a large number of examinations, taking samples of the water at different seasons of the year, when the river is full, and when it is low.

The Blackstone River was chosen for this investigation. This river is situated mainly in Worcester County, and on its banks are located many woollen and other mills, wire-works, etc.; moreover, it receives the entire sewage of the city of Worcester, as has been stated in a previous portion of this Report. The river is formed by the junction in South Worcester of two brooks,—Mill Brook and Kettle Brook. Kettle Brook rises in ponds in Auburn, and although it will eventually receive a portion of the sewage of Worcester, and although even at present there are a few manufactories on its banks, it may now be regarded as practically unpolluted, as will be seen from the examination below. Mill Brook, on the contrary, is a very foul stream; it rises in the north-east part of Holden, and flows through Worcester, receiving the drainage from several manufactories, and the whole sewage of the city (1,500,000 gallons daily). On the river, below the junction of the two brooks, are located the Quinsigamond iron and wire works, and from Quinsigamond village to Millbury the river flows between low banks. Between these

points there are one or two mills supplied with water from the old Blackstone Canal. In Millbury and Wilkinsonville (in Sutton) there are a number of manufacturing establishments, and the river receives accessions from several brooks and small streams. Between Saundersville and Farnumsville (in Grafton) the river is joined by a stream from Lake Quinsigamond. Thence the river flows through Northbridge and Uxbridge, in which latter town it is joined by the Mumford or Manchaug River, a stream which draws its supply from ponds in Douglas and Whitinsville (in Northbridge). South of the village of Uxbridge, the Blackstone is joined by the West River, and then flows through the town of Blackstone into Woonsocket, Rhode Island. The length of the Blackstone, from the junction of Mill Brook and Kettle Brook in Worcester to the state line, is about twenty-five miles.

The West River, which joins the Blackstone south of Uxbridge, is a stream of considerable size, which comes from the north-west part of Grafton and the northern part of Upton. Like the Blackstone, it supplies numerous factories with water and receives their drainage.

The population of the towns through which the river flows was, according to the U. S. Census of 1870, as follows :—

Auburn,	1,180
Worcester,	41,115
Millbury,	4,400
Grafton,	4,595
Sutton,	2,699
Northbridge,	3,775
Uxbridge,	3,062
Blackstone,	5,421
	66,247

The population of Woonsocket, R. I., was in 1870, 7,698 persons.

Mill Brook.—Examinations of the water of Mill Brook above and below the city of Worcester, were made at various times; the results are presented in the following table :—

TABLE VII.—*Examination of Mill Brook, Worcester.* (Results expressed in Parts per 100,000.)

Number.	LOCALITY.	Flow in Cubic Feet per second.	SOLID RESIDUE OF— Filtered Water.	SOLID RESIDUE OF— Unfiltered Water.	Suspended Matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrates and Nitrites.	Remarks.
9	Above sewers, ...	–	11.98	–	–	0.815	0.543	–	–	0.0597 Phosphoric acid.
14	" "	–	5.50	6.00	0.50	0.476	0.442	0.5	–	0 " "
15	Below sewers, ...	–	8.60	11.00	2.40	0.102	0.034	1.9	–	0.0255 " "
16	Above sewers, ...	–	11.00	11.50	0.50	0.544	0.884	0.5	–	Trace " "
17	Below sewers, ...	–	10.50	14.00	3.50	1.360	2.006	2.0	–	0.0512 " "
77	Above sewers, Oct. 15, 9.30, A. M.,	44.28	6.80	9.60	2.80	0.063	0.030	1.2	0.025	– –
78	" " " 15, 1.30, P. M.,	44.69	4.00	6.50	2.50	0.100	0.037	1.6	0.029	– –
79	" " " 15, 6.00, P. M.,	47.96	55.30	61.50	6.20	0.033	0.030	–	0.050	Large amount of sulphate of iron.
80	Below sewers, " 15, 9.15, A. M.,	29.22	11.50	19.20	7.70	0.150	0.065	3.6	0.111	– –
81	" " " 15, 2.10, P. M.,	37.32	6.80	11.50	4.70	0.225	0.055	2.0	0.073	– –
82	" " " 15, 5.30, P. M.,	31.59	13.50	16.20	2.70	0.150	0.050	4.0	0.140	– –
83	Above sewers, " 17, 9.20, A. M.,	40.46	7.80	–	–	0.063	0.025	1.2	0.029	– –
84	" " " 17, 2.15, P. M.,	41.61	8.00	–	–	0.015	0.025	1.2	0.027	–
85	" " " 17, 5.40, P. M.,	40.29	6.50	–	–	0.020	0.030	0.8	0.037	– –
86	Below sewers, " 17, 8.45, A. M.,	32.44	20.90	–	–	0.300	0.040	2.8	0.142	– –
87	" " " 17, 2.45, P. M.,	39.21	7.70	–	–	0.280	0.075	4.0	0.140	

88	Below sewers, Oct. 17, 6.00, P. M.,	42.35	9.70	–	–	0.200	0.030	2.0	0.074	–	
93	Above sewers, " 29, 8.30, A. M.,	16.17	24.60	–	–	0.055	0.035	6.8	0.029	–	–
94	" " " 29, 12.30, P. M.,	17.91	13.00	–	–	0.050	0.050	0.8	0.053	–	–
95	" " " 29, 5.10, P. M.,	25.24	17.80	–	–	0.130	0.030	1.6	0.045	–	–
96	Below sewers, " 29, 9.00, A. M.,	22.91	15.80	–	–	0.500	0.070	2.8	0.084	–	–
97	" " " 29, 12.00, P. M.,	24.00	21.40	–	–	0.300	0.050	2.4	0.070	–	–
98	" " " 29, 6.00, P. M.,	28.79	16.50	–	–	0.200	0.050	2.8	0.070	–	–
	Above sewers, av'ge of 12 samples,	–	15.71	–	–	0.197	0.180	1.62	–	–	–
	Below sewers, av'ge of 11 samples,	–	14.90	–	–	0.343	0.229	2.74	–	–	–

As all the sewage of Worcester drains into the brook, it was at first thought that it might be possible to make some approximate calculations as to the amount of polluting matter, by a comparison of the water of the brook above and below the city. Owing, however, to the intermittent use of the water by manufactories, and to the nature of the bed of the stream, it was found impossible to draw conclusions from these examinations; the results obtained, however, show the character of the stream which below the city is practically an open sewer.

Blackstone River.—The examination of the river itself was made at two separate times. On September 28 we visited Blackstone and followed the course of the river to Worcester. The day preceding there had been a heavy rain, and the river was quite full, as indeed it has been throughout the season. Samples of the water were taken at various points. The river below Blackstone was somewhat colored but quite clear, there being no more color than would be naturally expected in the case of a river flowing as this river does for a considerable part of its course between low banks covered with grass and trees. There was no particular odor or disagreeable taste. It was stated by the hostler at one of the stables, that the water was used in watering horses and cattle. At other points of the river the water was very similar in appearance. The samples were taken from the following points:—

No. 66. Blackstone River near Rhode Island line, beyond Blackstone.

No. 67. Blackstone River between Millville (in Blackstone) and Uxbridge, where the road crosses the river on a wooden bridge. The mills at Millville are not now running.

No. 68. Blackstone River at Uxbridge near the woollen mill of Robert and Jacob Taft.

No. 70. West River. Beyond Uxbridge and below Wheelock's Woollen Mill.

No. 71. Manchaug (or Mumford) River at Uxbridge at the bridge near the Station on the Providence and Worcester Railroad.

No. 72. Blackstone River at Northbridge Station. Just below a large cotton factory.

No. 73. Quinsigamond River, a short distance above its junction with the Blackstone.

No. 74. Blackstone River in Saundersville (Grafton), just before it joins the stream from Lake Quinsigamond.

No. 75. Blackstone River just below Millbury Village.

The upper part of the river was subsequently visited on November 8th. Heavy rains had fallen for several days previous and the river was very full. Samples were taken at several points as follows:—

No. 103. Blackstone River at Millbury, at bridge just below the railroad station.

No. 102. Blackstone River at railroad bridge, a few rods above the station.

Between Nos. 102 and 103 there is a dam and a factory. The water as it flowed over the dam was seen to be quite turbid and considerably colored. In *appearance* the river on the occasion of both visits was the worst at this point.

No. 101. Blackstone River at the stone bridge near the Quinsigamond Iron and Wire Works, Quinsigamond Village, Worcester.

No. 100. Kettle Brook just before it is joined by Mill Brook.

No. 99. Mill Brook just before it unites with Kettle Brook.

The results of the chemical examination of the waters collected at the times of the several visits are given in the following table, together with the results of the examination of two specimens (Nos. 104 and 122) received at later dates from Dr. Geo. E. Bullard, correspondent of the Board at Blackstone.

No. 104. This sample was taken from the same locality as No. 66, November 18, 1872.

No. 122. This sample was taken below Woonsocket, in Rhode Island, the afternoon of December 3.

TABLE VIII.—*Examination of Blackstone River.* (Results expressed in Parts per 100,000.)

Number.	LOCALITY.	Dissolved matters.	Suspended Matters.			Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Date of Sample.
			Mineral.	Organic.	Total.					
99	Mill Brook, Worcester, ...	12.30	2.02	1.55	3.57	0.1580	0.1200	2.00	0.1730	Nov. 8.
100	Kettle Brook, Worcester, ...	6.50	0.65	0.63	1.28	0.0120	0.0250	T e.	0.0170	"
101	Blackstone River, Worcester, ...	8.00	1.60	–	–	0.0450	0,0400	0.80	0.0188	"
102	" " Millbury, ...	5.00	1.10	0.10	1.20	0.0450	0.0400	1.20	1	"
103	" " "	5.70	1.10	0.37	1.47	0.0370	0.0250	1.20	0.0900	"
75	" " "	7.08	–	–	–	0.0340	0.0252	0.65	0.0477	Sept. 28.
74	" " Saunderville, ...	6.24	–	–	–	0.0192	0.0232	0.50	0.0467	"
73	Quinsigamond River, ...	3.40	–	–	–	0.0040	0.0216	0.25	0.0199	"
72	Blackstone River, Northbridge, . . .	6.68	–	–	–	0.0120	0.0224	0.30	0.0436	"
71	Manchaug River, Uxbridge, ...	4.20	–	–	–	0.0052	0.0212	0.28	0.0137	"
70	West River, Uxbridge, ...	3.84	–	–	–	0.0040	[illegible]	0.02	0.0190	"
68	Blackstone River, Uxbridge, ...	5.68	–	–	–	0.0056	0.0224	0.22	0.0292	"
67	" " "	5.08	–	–	–	0.0032	0.0200	0.30	0.0127	"
66	" " Blackstone, ...	4.80	–	–	–	0.0032	0.0192	0.23	0.0240	"
104	" " "	6.50	–	–	0.50	0.0650	0.0350	0.60	0.0199	*Nov. 18.
122	" " Woonsocket, ...	[illegible]0	–	–	0.60	0.0500	0.0250	0.20	0.0395	*Dec. 3.
129	Boston water supply, Nov. 20, 1872, . .	8.00	–	–	–	0.0080	0.0160	0.50	0.020	–
	" " " Dec. 12, " . .	5.28	–	–	–	–	–	–	–	–
	" " " Dec. 17, " . .	5.24	–	–	–	–	–	–	–	–

* Two liters of each, 104 and 122, evaporated to small bulk failed to give indications of arsenic, which is often found in appreciable quantities in the rivers of England which drain manufacturing districts.

In this table the samples are arranged according to the localities from which they were taken, proceeding from the head-waters toward the mouth of the river. An inspection of the tables shows that the condition of the river is not as bad as might be expected from the number of manufacturing establishments upon its banks. Although one of the streams which unite to form the river is extremely foul (being, in fact, dilute sewage), yet we find that the amount of impurity from this and other sources which remains in the river, by the time it reaches Blackstone is very small, compared with the bulk of water. It is to be remarked, that the examination was made at a time when the river was quite full, and after a wet season. No doubt there would be found, during a hot and dry summer, an increased amount of impurity. We are informed by Dr. Bullard, that at Blackstone the water is drunk by horses, and that stable-men have noticed no material change in the river for fifteen years, except during the summer of 1871, when the river was low; at that time the water was not fit even for horses to drink. For the sake of comparison, there are inserted in the table the results of the examination of the water supplied to the city of Boston, as drawn from the pipes in the laboratory of the Institute of Technology, November 20, 1872.

Merrimac River at Lowell.—In addition to the examination of the Blackstone River and its tributaries, as already detailed, a single suite of specimens from the Concord and Merrimac Rivers at Lowell has been analyzed. The samples were taken Saturday afternoon, November 30, 1872. The day was a very cold one, and ice was forming on the sides of the streams. The rivers were not as full as a few weeks previously, but yet they were quite full. The following table shows the results of the analyses:—

TABLE IX.—*Examination of Merrimac River at Lowell.* (Results expressed in Parts per 100,000.)

Number.	LOCALITY.	Solid Residue of— Filtered Water.	Solid Residue of— Unfiltered Water.	Suspended Matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrates and Nitrites.	Remarks.
117	Merrimac River, above dam, at entrance of new canal, .	2.60	3.10	0.50	0.030	0.035	0.16	0.0096	– –
118	Concord River, at 7-arch bridge, near cemetery. . . .	2.60	4.40	1.80	0.020	0.050	0.30	0.0082	– –
119	Concord River, East Merrimac Street Bridge (just before junction with Merrimac), .	5.10	5.70	0.60	0.023	0.043	0.34	0.0216	Tested for nitrites, the waters ranged themselves in this order: 117, 121, 119, 118, 120.
120	Merrimac River (above Central Bridge, just before junction with Concord River), .	3.60	5.40	1.80	0.025	0.050	0.17	0.0096	Tested for sulphates, Nos. 119 and 121 gave a distinct reaction; the others gave only a very faint reaction.
121	Merrimac River, 3 miles below Lowell, ...	4.50	6.20	1.70	0.022	0.024	0.30	Trace.*	– –
129	Boston water, Nov. 20, 1872, .	8.00	–	–	0.008	0.016	0.50	0.0200	– –
	Boston water, Dec. 12, 1870, .	4.20	–	–	–	–	–	–	– –

* Amount undetermined.

It would thus appear that for the present, the rivers of Massachusetts are not polluted to such an extent as to cause alarm, and yet neither the Blackstone River nor the Merrimac below Lowell would be recommended as a source of supply for a city. It is, however, to be borne in mind, that our manufactures and, consequently, the population of our manufacturing towns, are rapidly increasing, and that in the case of the larger towns, more efficient systems of water-supply and of sewerage are being rapidly introduced. The day is probably far distant, when we shall reach the state of things at present existing in the manufacturing districts of England, but, in many cases, it will only be a question of time; it is hoped, however, that further examination may lead to suggestions which will tend to prevent the unnecessary abuse of running streams. It seems to us that there will be no difficulty in preserving the purity of our larger streams to such an extent that the fish will continue to live in them, that cattle will not refuse to drink their waters, and that they may serve the purposes of the manufactories on their banks. As to the employment of the water for drinking purposes, it will be shown that the lakes of the Commonwealth offer an abundant supply of potable water, and the use as a source of water-supply, of running water which has, in any part of its previous course, been contaminated with sewage is, to say the least, of questionable advantage.

In order that the present very tolerable condition of our rivers may not be regarded as affording a reasonable pretext for neglecting all attempts to preserve their present state of purity, it may not be amiss to state, with some little detail, the condition of the streams flowing through the manufacturing districts of England.

Condition of certain English Rivers.—The effect of the drainage of sewage and manufacturing refuse into the rivers of England and Scotland, has been the subject of a very thorough investigation by two Royal Commissions, appointed respectively in 1865 and 1868, and allusion has already been made to the very valuable published reports of these Commissions, "appointed to inquire into the best means of preventing the pollution of rivers."

A few quotations from these reports will show the extent to which a densely-settled manufacturing country may pollute its running streams. Personal observation of some of the streams mentioned below has convinced us that the matter has in no whit been overstated. Take, for example, the rivers Aire and Calder in the West-Riding of Yorkshire. This district includes the large manufacturing towns of Leeds, Bradford, Huddersfield, etc. The area of the basin of the two rivers is 508,160 statute acres, and the population in 1861 was 943,677, or about 1,200 to the square mile. The sewage of Leeds alone, amounts to eight or ten million gallons daily. Of these rivers the Commissioners say:—

"The rivers Aire and Calder, and their tributaries, are abused by passing into them hundreds of thousands of tons per annum, of ashes, slag and cinders from steam-boilers, furnaces, iron-works and domestic fires; by their being made the receptacle, to a vast extent, of broken pottery and worn-out utensils of metal, refuse brick from brickyards and old buildings, earth, stone and clay from quarries and excavations, road-scrapings, street-sweepings, etc.; by spent dye-woods and other solids used in the treatment of worsteds and woollens; by hundreds of carcases of animals, as dogs, cats, pigs, etc., which are allowed to float on the surface of the streams, or putrefy on their banks; and by the flowing in, to the amount of very many millions of gallons per day, of water poisoned, corrupted and clogged by refuse from mines, chemical works, dyeing, scouring and fulling worsted and woollen stuffs, skin-cleaning and tanning, slaughter-house garbage, and the sewage of towns and houses."—(Third Report of the Commissioners appointed to inquire into the best means of preventing the pollution of rivers. [Rivers Aire and Calder.] 1867. Vol. I., p. xi.)

Many of the forms of pollution mentioned in this extract, such as ashes and broken pottery, could, without difficulty, be kept out of the streams: the great temptation is, of course, to run into the rivers such refuse as is already in solution, or in suspension in water. The effect of all this pollution of the rivers (leaving out of account the solid material which accumulates so as to obstruct navigation), is to render the rivers not only unfit for drinking and for other domestic purposes, but also to injure them for manufacturing uses, and to offend the senses and injure the health of the dwellers upon the banks, and to render them entirely uninhabitable by fish.

Take the case of Bradford.

"Bradford is an ancient town, situated on a 'beck' about four miles south of the river Aire, into which the water of this beck falls. It is the centre of

the worsted district. The population of the borough increased from 103,000 in 1851 to 106,000 in 1861, but the increase in the value of goods manufactured was enormously in excess of the increase of population. The contamination of the streams has increased, rather according to the growth of the trade, than with the increase of local population. There is increased pollution from dye-works, from soap-suds and from refuse of various kinds produced in manufactures. The whole of the sewage of Bradford and of the populous district above the town flows into the beck, producing an indescribable state of pollution. It has become a Yorkshire proverb of comparison for any foul stream to say of it, that it is as polluted as Bradford Beck. At the time of our inquiry, Bradford Beck was the source of supply of the Bradford Canal, the fluid of whch became so corrupt in summer that large volumes of inflammable gases were given off, and although it has usually been considered an impossible feat 'to set the River Thames on fire,' it was found practicable to set the Bradford Canal on fire; as this at times formed part of the amusement of boys in the neighborhood. They struck a match, placed on the end of a stick, reached over, and set the canal on fire, the flame rising six feet high and running alone the surface of the water for many yards, like a will-o'-the-wisp; canal boats have been so enveloped in flame as to frighten persons on board."

"The injury inflicted by the river pollutions of these and other towns to the estates of many riparian owners is very great; streams which in the memory of men now living were comparatively pure and well stocked with fish, are now black and stinking.

"The land through which such polluted streams flow is ruined for residential purposes, and is injured and reduced in value even for mill purposes; the water is so bad as to be considered unfit for manufacturing uses, and other sites are selected where water can be obtained from canals, or by sinking wells and boring. In many instances cattle will not drink the local river-water, and farms are depreciated in consequence.

"Large country-houses which formerly, with their river-frontage, rights of fishing, and ornamental gardens and pleasure grounds, were valued as residences, have been abandoned, or are let merely at farming rents and for farm purposes.

"The cattle plague prevailed to a great extent in the Thorp Hall meadows below Leeds, and on lands bordering foul rivers in other districts.

"This fatal disease was considered by the tenants and riparian proprietors to have been aggravated by the foul state of the water, and by the tainted atmosphere caused by river pollutions. The towns are poisoned in some degree by their own sewage and cess-pool matter, and are taxed to a considerable extent to remove this putrid refuse in a most barbarous manner. Manufacturers pollute the water for each other until the streams have to be abandoned for all but the coarsest purposes of trade, and clean water has to be purchased from water-works companies, or must be sought at great cost in well-sinking and boring, to which must be added the charges for extra steam-power. In some cases the manufacture and dyeing of finer sorts of goods have been necessarily abandoned, and in other cases extension of manufacture is rendered impossible, because there is no additional volume of clean water to be obtained in the district."*

* Rivers Pollution Commission, Third Report. 1867. pp. xxxviii and xlii.

The Rivers Commission in their report present a very striking "fac-simile of a memorandum written with the water of the river Calder, taken at the point where the Wakefield sewer joins the river." The fac-simile appears as if written with ink, a trifle pale perhaps, but still very distinctly legible. The writer dedicates what is written "without permission" to the Board of Health of Wakefield, and says, "Could the odor only accompany this sheet it would add much to the interest of this memorandum."

These rivers which have been mentioned are not the only ones polluted: the same condition of things exists throughout the manufacturing districts. In the Lancaster district, the river Irwell, which flows into the Mersey, has a drainage-area of about 312 square miles with a population in 1861 of 3,255 to the square mile. Near its source "it is of excellent quality for all domestic purposes." It flows, however, through the midst of a manufacturing district; and finally passes through Manchester before it empties into the Mersey. At Manchester the sluggishly flowing stream is black as ink and is there joined by the Irk and Medlock, streams not less polluted than itself. The Commissioners say:—

"Between the mouth of the Irk and the weir at Throstlenest, there are no fewer than fifty-one different manufacturing establishments on the banks of the Irwell itself, in addition to all the others scattered about the town and on the banks of the various rivers and streams, all discharging themselves eventually into the Irwell. This enumeration of the factories both in Manchester and elsewhere on the banks of the Irwell itself, is however a very imperfect illustration of the manufacturing industry of this river-basin generally; for we learn from statements made with regard to the water-supply, that, in addition to those which have independent resources, there are no fewer than 10,500 factories and works of all kinds within the Irwell basin, which are supplied from the water-works of Manchester, Bolton, Bury, Bacup, Heywood, and Oldham alone.

"The population congregated on both sides of the river in the city of Manchester and the borough of Salford exceeds 500,000, and a rapid addition is being made to this number. Large sums of money have been expended upon public works of various kinds; and a system of sewerage has been carried out by which the ordinary drainage of both towns passes into one or other of the streams which intersect them, and finds its way ultimately into the Irwell. This drainage consists, in the first place, of the rainfall over an area of about 10,000 acres; and, in the second place, of the water brought in for the supply of the inhabitants, which, estimated at the rate of twenty gallons per individual, amounts in round numbers to 10,000,000 gallons per day. A portion of this has of course been employed for manufacturing purposes, and is passed into the streams in a more or less polluted

state. The remainder reaches the sewers after use for various domestic purposes, some of it passing through privies and water-closets, and thence carrying with it large quantities of excrementitious matter."

The condition of the different streams flowing through Manchester,—the Irk, the Medlock, the Cornbrook,—and that of the Irwell, which is the recipient of all that is brought down by these streams as well as of much which is passed directly into it by the sewers, being such as has been described, it is no wonder that the authorities of Salford (a suburb of Manchester) say: "The condition of the river is indirectly a source of ill-health and discomfort, and the condition of certain open water-courses acts in a direct manner on the health and comfort of the district." A stranger visiting Manchester and observing the Irwell winding through the parks in the suburbs of the city, would hardly think of this river, which but for its stygian aspect would be a thing of beauty in the landscape, that it had once flowed an unpolluted stream inhabited by fish.

In Scotland in the case of many of the rivers a condition of things not much better prevails. A single quotation will suffice. It is the statement of a riparian proprietor in regard to the river Tweed:—

"The river Tweed bounds my property for about one-third of a mile. My house is situated about 250 yards above the river on a rising ground. When I first came to the place, in summer there was a slight stench, but not so very bad as to attract attention. The water was filthy when the river was very low, but of late years it has become much worse, and in summer-time now the stench of it is perfectly odious, and the color of the water at certain times, for instance on Saturday afternoons, is very bad, especially about three o'clock; it comes down blue, red and green, with masses of woollen stuff floating on it. As there is a weir at Melrose just immediately below my property, it creates a great pool in which this stuff or a considerable part of it settles. The result is that the bed of that pool has become perfectly filthy, so that if a dog goes into it, he comes out just exactly as if he had escaped from a dye-vat."

The quotations show to what extent the pollution of streams may be carried. It is, however, true that much of this pollution might be avoided, and the polluting material might even be made a source of profit; at any rate, it will, no doubt, be of importance to ascertain as soon as it can be done, in the case of all the rivers in the State, or flowing through it, to what extent polluting matters are carried into

the streams, and how far this discharge might be avoided so as to put far off the evil day. It is true that there are already some small streams in the State which are now polluted to a considerable extent: such are Mill Brook (Worcester), Stony Brook (Roxbury), Neponset River and a brook visited several years ago in Melrose. These streams resemble some of the smaller English rivers: they seem hopelessly polluted; there is, however, no question but that the condition of even these streams might be improved, although such purification would be attended with considerable expense.

Alleged Self-Purification of Running Streams.

It is a wide-spread popular idea, that no matter how much impurity is discharged into a running stream, yet by flowing a dozen miles or so, the stream will for all practical purposes free itself from the impurity and become fit for use even as a source of water-supply. It has been alleged that the organic matter is almost completely oxidized by the oxygen of the air and by that dissolved in the water, and that this oxidizing action is very much increased, if the water be agitated by passing over weirs or natural falls. This feeling has gained considerable currency and has been held by some men who are looked to as authorities, such as Dr. Miller, Dr. Odling and Dr. Letheby: it is, however, unsupported by direct proof; in fact, the experimental evidence leads us to the contrary opinion. The Rivers Pollution Commission made this question the subject of direct investigation, and showed very conclusively that the commonly received opinion was erroneous. They chose localities on several streams where the rivers, in each instance, flowed for almost a dozen miles without receiving additional pollution, and determined the amount of organic matter destroyed. They also made mixtures of ordinary sewage with different quantities of water, and in these artificial mixtures, which were, by various devices, exposed to the free action of the oxygen of the air, they determined the rate at which the organic matter disappeared. This they did by estimating from time to time the organic nitrogen and carbon contained in the solution; also by observing the rate at which the dissolved oxygen

disappeared. As a result of these experiments they affirm that,—

"It is evident, that so far from sewage mixed with twenty times its volume of water being oxidized during a flow of ten or twelve miles, scarcely two-thirds of it would be so destroyed in a flow of 168 miles at the rate of one mile per hour, or after the lapse of a week. In fact, whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of sewage when the latter is mixed with fresh water and violently agitated in contact with air, or finally, the rate at which dissolved oxygen disappears in water polluted with five per cent. of sewage, we are led in each case to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness, even when the sewage is mixed with a large volume of unpolluted water, and that it is impossible to say how far such water must flow before the sewage-matter becomes thoroughly oxidized. It will be safe to infer, however, from the above results that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation.

"These results confirm the opinion arrived at from theoretical considerations, and expressed by Sir Benjamin Brodie in his evidence, given before the former Rivers Pollution Commission (First Report, River Thames, Vol. II., Minutes of Evidence, page 49). His evidence was to the following effect:—

"'I should say, that it is simply impossible, that the oxidizing power acting on sewage, running in mixture with water over a distance of any length, is sufficient to remove its noxious quality. I presume that the sewage can only come in contact with oxygen from the oxygen contained in the water, and also from the oxygen on the surface of the water; and we are aware that ordinary oxygen does not exercise any rapidly oxidizing power on organic matter. I believe that an infinitesimally small quantity of decaying matter is able to produce an injurious effect upon health. Therefore, if a large proportion of organic matter was removed by the process of oxidation, the quantity left might be quite sufficient to be injurious to health. With regard to the oxidation, we know that to destroy organic matter the most powerful oxidizing agents are required; we must boil it with nitric acid and chloric acid and the most perfect chemical agents. To think to get rid of organic matter by exposure to the air for a short time is absurd.'"

If the results of these experiments are conclusive, how does it happen that while so much foul matter is even now being poured into our rivers, that they are yet no worse? There are several things to be considered: in the first place, there is continually going on a deposition of suspended matters, and of insoluble substances formed by the chemical changes taking place in the liquid. To illustrate this subsidence from chemical change: an examination of the sample of water from Mill Brook, numbered 79 (which contained a large quantity of sulphate of iron), was made October 17; some of the water was then allowed to remain

in a closed bottle, half-filled with air. The amount of suspended or rather sedimentary matter, at first small (6.2 parts in 100,000), soon began to increase, and was of the well-known red color of oxide of iron. On November 16, a portion of the liquid was filtered, and it was found that the amount of iron in solution had decreased from 23.6 parts in 100,000 to 6.15 parts. The hydrate of iron precipitating under such conditions, drags down with it more or less organic matter, and this oxidation of the sulphate of iron and the precipitation of the hydrated oxide of iron would take place in the running stream, especially when the stream flows as the Blackstone does for considerable portions of its course, with a slight descent. At the time of our examination of the Blackstone, the river appeared most turbid and colored in the neighborhood of Millbury: at Northbridge, six or seven miles below, the river was improved in appearance, although it had passed several mills.

Again, the river is continually receiving accessions to its volume, sometimes, to be sure, from streams more or less polluted, but more often from streams as yet uncontaminated, or from lakes, the banks of which are still in their natural state. Moreover, the drainage from the high surrounding country, filtering through the earth, enters the river somewhat hard; perhaps from the presence of mineral matters held in solution, but containing only a small amount of organic impurity.

These facts alone are sufficient to account for the apparent disappearance of a large amount of organic matter, but while we do not overrate its effects, we must not fail to give due weight to the oxidation continually going on. It would seem from the experiments of the Rivers Commission, that in a flow of a dozen or twenty miles, as much as 20 or 30 per cent. of ordinary sewage-impurity might, in summer weather, be destroyed by oxidation. It must be borne in mind, however, that for all we know, the portion remaining unoxidized may be the very portion most injurious to health. If certain diseases be propagated by germs,—by living organisms,—we may well suppose that such germs would live, although dead organic matter might be destroyed. In expressing our own conclusions on this subject, we perhaps

cannot do better than quote the words of Dr. Frankland, the most eminent chemical authority on the sewage question:—

"There is no process practicable on the large scale by which that noxious material (sewage-matter) can be removed from water once so contaminated, and, therefore I am of the opinion that water which has once been contaminated by sewage or manure matter, is thenceforth unsuitable for domestic use."

The Water-Supply of Towns.

We have seen to how great an extent the streams of Massachusetts, of whatever size, whether rivers like the Connecticut and Merrimack, or brooks like Mill Brook in Worcester, or Stony Brook in Roxbury, are made carriers of waste materials. The smaller of these streams, if running through districts filled with manufacturing establishments and a crowded population, are already spoiled for use as drinking-water.*

Rivers like the Blackstone can be still used for watering horses and cattle, except in seasons whan the volume of water is much diminished by drought, but we find no towns on its banks taking the water for general use, or proposing to do so. Our largest rivers are generally regarded as not so impure as to be unfit to drink. The Merrimack water is being taken at the present time above Lowell, to be filtered through earth, and then distributed to the people of that city.† Several municipalities on the banks of Charles River have sufficient confidence in the character of its water to wish to take it for general use, and are now preparing extensive works for that purpose.

Boston has recently added the waters of Sudbury River to its former supply from Lake Cochituate. A pressing and immediate necessity in the case of Boston may justify this course, but we believe the character of the water which this

* A tannery, or wool-pulling establishment, or any other place where the *hides* of either cattle, sheep or hogs (whether separated from the body or not) are dressed and fitted for their subsequent uses, will foul a little brook so that cattle will refuse to drink from it for miles below. The waste of breweries and the waste of a crowded population have made Stony Brook in Roxbury foul and stinking. Not many years ago it was a clear stream. It is now a sewer.

† The wells of Lowell are known to be so foul that many persons now prefer to drink the river-water, taken from the canal which supplies the mills with water-power.

city has previously enjoyed, will deteriorate by the contributions of a stream running through a country which will, at no very remote day, be densely populated.

Unless legislation to prevent the pollution of streams can be better enforced in Massachusetts than in England, we may conclude that the spoiling of our rivers as sources of water-supply, is a question of time, of density of population and of their size. The little brooks will go first,—streams like Mill Brook and Stony Brook will follow,—rivers like the Blackstone, Nashua, Charles, Sudbury, Housatonic and Concord will be next in order, and their deterioration will correspond with the number of people living on their banks. The Connecticut and Merrimack will longest resist the polluting influences, by reason of the volume of their waters.

In England the greatest efforts have been made to secure the purity of streams. The case is indeed an urgent one, much more so than with us, because the streams and wells are practically the only sources of water for the large towns. In examining the English reports on the subject, no one can fail to see that the laws cannot be so enforced as to effect the desired result. The most stringent regulations are made by Parliament, at the instance of "Rivers Pollution Commissions" and "Sewage of Towns Commissions," but the rivers grow more and more foul in spite of them. The temptation to use the streams as sewers is stronger than the fear of the law which seeks to protect them.

London is compelled to use the upper waters of the Thames for the supply of her three millions of people, and under this extreme necessity, and through the coöperation of the various companies who distribute the water, no doubt a good deal of refuse is kept out of that stream. The water is filtered by the companies before being delivered through the mains, and is again filtered before use by many consumers; and after all these precautions it is obviously impure and unsatisfactory. It is a constant subject of discussion among the people, and weekly reports of its character, and of the amount of the "previous sewage contamination" which it holds are made by chemists employed by the government. There can be no doubt that the very extensive (almost universal) use of alcoholic drinks as an ordinary daily beverage

by all classes and conditions, and by both sexes in England, is due in part to the fact that water of unquestionable purity is so very difficult to obtain.*

Is it unreasonable to suppose that the same causes which have spoiled the English rivers will in time spoil ours also? The census of 1870 shows us that if the rate of increase of population in Massachusetts since 1865 is continued for twenty-five years, our whole territory will at the end of that time contain as many people to the square mile as the England of to-day. Eastern Massachusetts will of course be even more populous. Let us then be wise in time, and provide, if possible, for the future necessities of the people, by comprehensive plans which will not merely supply single towns, but the whole community of towns.

A suburban or rural village in Massachusetts may have been furnished with good water from the wells about the houses for an indefinite period, and everybody has been content. But the village becomes a town, and its population is quadrupled by manufacturing establishments. The subsoil water is unequal to the demand made upon it, and wells are sunk deeper, the shallow wells are drained, and neighbors compete with each other in cutting off the fair allowance of what justly belongs to all. While this is going on it is also observed that the water is less pure.† It is fouled by the drainage of privies, and the liquid waste thrown upon the ground. Then comes a general demand for a supply of pure water from other sources. Application is made to the legislature for liberty to tap the nearest pond, or divert the waters of any neighboring stream, which may at the time be free from obvious contamination. And under the pressure of this immediate demand for good water, little thought is given to the fact that the same causes which ruined the family well may also in time destroy the source of the town's sup-

* London water is "let on" for one or two hours of each day, except Sunday, when every householder draws at least one day's supply, which is stored in reservoirs on the premises. Such restrictions must diminish its freshness and coolness, and seriously interfere with its most healthful uses.

† The following table shows the amount of impurity recently found in certain wells in Eastern Massachusetts by Mr. S. P. Sharples, who published the results in the "American Chemist" for November, 1872. It by no means represents the general character of our wells, but shows how bad they may become by intercepting the drainage of barn-yards, privies and other sources of filth. In the case of the well at

ply. In some instances several towns on the banks of a stream seek authority to take its waters, and having taken and used them, they must carry them back again by sewers to the same stream, unless the proximity of tide-water enables them to turn the sewage into some estuary. When Waltham and Brookline and West Roxbury so use the water of Charles River, they cannot be surprised if Dedham and Natick and other growing towns above them ask for the same privilege at no distant day. One may readily see what trouble and legislation may in this way be entailed on future generations. We fear that "Charles River Conservancy Boards" will hardly succeed any better in keeping sewage from that river than similar boards have done in England.

*Lakes and "Great Ponds."**

In seeking a remedy for this inevitable difficulty in the future,—a remedy which shall be of general application, and which, if made a part of the state policy, would go very far towards furnishing the people with pure drinking-water in all coming time, we find it in rejecting the streams, and looking to the *lakes* and *great ponds* as sources of water-supply.

It would be an interesting subject of inquiry to trace the various causes, which have made the banks of our rivers the seats of industry and of population, and have left the banks of our great ponds to comparative solitude. Such considera-

Webster, it is stated that the water was sweet and pleasant to the taste, but the family using it had typhoid fever, and this circumstance led to the examination. The numbers represent grains in one United States gallon.

LOCALITY.	Inorganic Matter.	Organic and Volatile.	Total weight of Residue.
Newton,	14.12	6.53	20.65
Waltham,	17.79	7.46	25.25
Waltham,	4.66	7.60	12.26
Hyde Park,	13.12	7.98	21.10
Andover,	8.14	8.46	16.60
Taunton,	9.91	8.74	18.65
North Cambridge,	16.42	8.75	25.17
Woburn,	62.71	10.78	73.49
Newton,	19.25	13.41	32.66
Andover,	40.59	16.03	56.62
Webster,	15.81	29.00	44.81
Chelmsford,	47.25	29.16	76.41
Andover,	3.79	33.54	37.33

* Ponds are legally designated "Great" when their area exceeds ten acres.

tions do not, however, immediately concern us. It is enough to know the fact, which is full of practical interest.

One fifty-fourth of the whole territory of Massachusetts is comprised within the areas of these natural lakes, or great ponds of over ten acres in extent. They may be described as a whole, and in general terms, as basins receiving the rain and snow falling on them directly, and also upon the adjacent country and thence conducted to them either by surface-drainage, by brooks or otherwise, by percolation through the soil of their boundaries, or through springs beneath their surface.

Their waters are generally of singular purity, and this is due to their secluded position, to the geological formation of the territory which they drain, and to their action as settling basins for all extraneous matter. They are indeed reservoirs provided by nature for the health and refreshment of the people, and we greatly desire that their providential escape from contamination up to the present day should be understood, and that the need of guarding and preserving them in the future for the public benefit should be appreciated.

There is no instance of a populous town having grown up on the banks of any one of these lakes in Massachusetts. The original settlers seem to have avoided them, and although in some cases towns have been extended to their shores, it would appear to have been an extension from necessity and not from choice. A few villages may be found about the outlets of the ponds, and these have generally had their origin in the water-power connected with the brooks which flow from them. As a general rule, however, the great ponds of the State are bounded by farms and by woodlands.

The capacity of these natural reservoirs for supplying our crowded population with pure water, is shown by lakes Cochituate and Wenham, and by Fresh and Mystic Ponds. These four lakes, which are no better than a hundred others within our borders, although more favorably situated for water-supply in the neighborhood of large cities, yield an average flow of about 25,000,000 gallons daily to the cities of Boston, Chelsea, Charlestown, Cambridge, Somerville and Salem, and to the town of Beverly.

In addition to this, there is an average daily waste, at the outlets of Wenham Lake and Mystic and Fresh Ponds combined, which must amount, according to the best estimates we have been able to collect, to about 30,000,000 gallons. The draft upon Lake Cochituate has for some years past, been as great as it could supply,—fifteen to eighteen million gallons daily. The capacity of these four lakes for furnishing water, may be therefore estimated at about 55,000,000 gallons.*

Appended to this Report will be found a statement, furnished by Mr. H. F. Walling, giving the area in acres of every "great pond" in Massachusetts, together with its name, the township in which it is situated and its outlet.

It seems to have been supposed until within a few years, that it was of the first importance, in order to save expense, that the surface of any lake should be higher than the point at which its water was to be distributed, in order to make the force of gravity available.

It is now seen, however, that by the aid of force-pumps and elevated reservoirs or stand-pipes, that a deficiency of natural elevation is very readily overcome.

This is done at Wenham and at Cambridge, and elsewhere, with facility, and at no enormous cost; certainly the expense of this machinery, and its care can bear no comparison with the interest on the outlay required to bring the water from very distant and elevated regions by gravity alone. The important point in this connection is to know that engineering skill can readily avail itself of any neighboring lake, whether it be above or below the town to be supplied with water.

There are also real advantages to be gained in the case of lakes at a low level. They have a better supply of water in dry seasons, and their constant yield is more sure. Wenham Lake illustrates this fact. It is but thirty feet above tide-water and comprises 255 acres, and the extreme difference of level of its surface, noted at all seasons, while supplying 1,300,000 gallons per day, and including the drought of the summer of 1871, has been but eleven inches.

* The daily supply of London is about 100,000,000 gallons.

Fresh Pond with an area of 175 acres, is also very near the level of the sea, is but little affected by drought, and supplies 1,700,000 gallons per day without any appreciable change of level. Lake Cochituate has an area of 690 acres and supplied from its own resources before the connection was made with Sudbury River, fifteen to eighteen million gallons daily. Its elevation is 125 feet above tide-water, and in seasons of drought, like the summer of 1871, its level was greatly reduced.

Great Ponds are Public Property.

By a wise provision of our forefathers the "Great Ponds" of Massachusetts are, with very exceptions, public, and not private property. This clearly appears by a decision of Judge Hoar, in October, 1862, in the case of "Inhabitants of West Roxbury *vs.* Enos M. Stoddard and another" (see Allen's Reports, vol. 7, page 158).

Great Ponds, containing more than ten acres, which were not before the year 1647 appropriated to private persons, were, by the colony ordinance, made public, to lie in common for public use. The boundary on a natural pond extends only to low-water mark; beyond this point they are public property, except in cases (which must be very rare) where private grants were made more than two centuries ago.

They are indeed possessions of great value; capable of being made to supply most of our cities and towns with the means of promoting temperance and health, of giving them in abundance one of the great essentials of comfort and convenience, and of encouraging every form of useful industry.

But their value in the future depends upon the care which is taken to protect them from pollution. Cities and towns are extending in every direction and threaten to encroach upon their shores. Unless the danger is appreciated and guarded against, some of our most valuable lakes will soon become receptacles for sewage, and the precious inheritance of the founders of Massachusetts will be squandered and lost.

As examples of this danger we would invite attention to Lake Cochituate and to Mystic Pond; the former supplying Boston and the latter supplying Charlestown, East Boston, Chelsea and Somerville.

Twenty-six years ago, when Lake Cochituate was first appropriated for its present use, its shores were occupied by farms. The village of Natick was a mile from its southern extremity. But Natick has now 7,000 inhabitants, and has extended northwards in the direction of the eastern side of the lake, and houses and manufacturing establishments are coming very near its border.

The natural drainage of the town is obviously into the lake. Natick must soon have sewers,—it already has private drains from factories and houses,—and unless attention is given in time to this state of affairs, the water-supply of Boston* must inevitably be affected in quality.

The following table of analyses will throw some light on this question, and also on the effect of adding the water of Sudbury River. Of the comparative influence of these two causes in producing the changes observed we can give no opinion, except to say that it seems probable that Sudbury River is chiefly responsible.

Cochituate Water in former days. (Parts in 100,000.)

ANALYZED BY—	Total Solid Matter.	Inorganic.	Organic and Volatile.
Professor Horsford, 1848, ...	5.35	2.90	2.45
Professor W. R. Nichols, Dec., 1870, .	4.20	3.08	1,12

Cochituate Water in Boston in 1872, since Sudbury River connection. (Parts in 100,000.)

Professor W. R. Nichols, Nov. 20, 1872, .	8.00	–	–
Dec. 12, 1872, .	5.28	3.00	2.28
Dec. 17, 1872, .	5.24	2.96	2.28
S. P. Sharples, Oct. 1, 1872, ...	4.79	2.01	2.78

Mystic Pond now receives, directly and indirectly, a great part of the sewage of Woburn and Winchester, including the refuse of the great tanneries in those towns. This fact, full of danger for the future, was made the subject of special investigation by the authors of the present Report, in 1870;

* See remarks of our correspondent at Natick, under "Health of Towns."

and their conclusions were, as before stated, published in the Second Annual Report of this Board, 1871. The evil has not diminished since that time, although many of the manufacturers have made efforts to prevent contamination of the water.

The remedy is clearly to be found in establishing a complete system of sewerage, for both the towns above mentioned, having its outlet in Mystic River below Medford.

How can our Great Ponds be preserved from pollution, so that they may be used when needed as sources of water-supply by the cities and towns of the Commonwealth? To accomplish this it seems essential in the first place, to forbid the entrance of any sewer or drain into any "Great Pond," or into any water-course having its outlet in a "Great Pond." And in the second place to either secure the possession of a strip of land of moderate width around their borders, or in some other way to prevent the erection of dwellings or factories within such limits, leaving this strip of land to act, under natural agencies, as a filter for the purification of all the water which may percolate through it from the adjacent country. Such a reservation would, in the neighborhood of great cities, furnish a delightful park and driveway, thus contributing to the health and enjoyment of the people in many ways.

The effect of woodlands surrounding our lakes and ponds is undoubtedly beneficial to their waters. They protect the banks from being washed away, and prevent the soil from being carried into the lakes by torrents of rain. They also equalize the supply of water from the surrounding water-shed.

Spongy woodlands are reservoirs of moisture, and regulators of the flow of springs. As a country is denuded of wood it becomes parched and arid by reason of the rapid conveyance of rain to the neighboring water-courses, whose banks are torn by their violence. There are many instances, both in our own and other countries, of regions, once fertile, becoming barren wastes through such wanton destruction of trees. For such reasons we would advise the preservation of trees around our lakes, and planting them wherever they do not now exist.

It is not our province to indicate the legal methods by which such preservation of the lakes and great ponds can be secured either by the action of the legislature, or of the cities and towns within whose boundaries they may be comprised, but we earnestly desire that the people of Massachusetts, should protect them for the benefit of future generations.

We have thus reviewed the subjects included in the order of the legislature as completely as the time allowed would permit. They seem to us of vast importance, and worthy of continued examination in future years.

[*The chemical portions of the preceding Report have been prepared by Prof. Nichols, who visited England during the summer of 1872, and saw the various attempts there making to purify and to utilize sewage. Most of the analyses were made in the laboratory of the Massachusetts Institute of Technology, under the personal direction of Prof. Nichols, by Miss Ellen H. Swallow, A.B. Those made in July and August, during the absence of Prof. Nichols, were conducted by Mr. Frank P. Pearson at the Bussey Institution in West Roxbury, the laboratory of which was kindly placed at our service by Prof. Storer.*

Sanitary questions, the subject of water-supply, and the arrangement of this Report have been in the hands of the Secretary of the Board. Economical questions have been divided between the authors, who are also jointly responsible for all statements both of fact and opinion.]

In the Appendix will be found :—

1. A report from Mr. Phinehas Ball, on the possibility of utilizing the sewage of Worcester.

2. A report from Mr. H. F. Walling, concerning the "Great Ponds" of Massachusetts.

APPENDIX A.

THE OPPORTUNITY AND POSSIBILITY OF UTILIZING SEWAGE IN THE CITY OF WORCESTER.

To the State Board of Health.

This paper is not contributed in order to impart information in relation to what has been accomplished by Worcester in utilizing sewage, for nothing has yet been done in aid of a solution of the difficult problem. Its aim is to point out the possibilities and to state some of the means that are at command by which a desirable result may be attained.

The necessity of the utilization of sewage follows almost inevitably from the present popular mode of conveying away from our habitations and workshops, the contents of water-closets and urinals, with sink and other washings, by the modern water-carriage system.

The full benefit of a public supply of water cannot be realized in the absence of sewers, nor can all the comfort and luxury of the family be enjoyed without the service of both the modern water-supply and effectual sewerage. The water-carriage system of conveying sewage from our premises, falls naturally into harmony with our present notions of the application of all labor-saving machinery to the promotion of human comfort and improvement.

Its popularity is derived from the fact, that after the apparatus of water-closet, urinal, sink, bath-tub and waste-pipe in the dwelling or manufactory are once properly arranged and connected with the sewer, their operations go on silently and constantly, with but little care or attention on the part of the users.

These conveniences, thus arranged, are salutary and beneficial in the highest degree in all populous districts, but the refuse mingling with the water used for a thousand domestic and manufacturing purposes, imparts to it so many defiling and polluting properties, that its removal by the present system only takes the nuisance from one locality and transfers it, greatly diluted, to another.

The sewer-system in all inland cities and villages, is forced to connect its outfalls with the nearest available brook or river, into which to deliver the contents, with their innumerable defilements.

These sewer-poisons contaminate the water in the streams, transforming that which, in its purity, is a blessing, into a nuisance and a source of disease.

Thus while the crowded population is relieving itself, effectually and economically, of its refuse and waste materials, it is turning

them over, in the shape of defiled water, to the injury and abridgment of the rights of every riparian owner.

Two objects are to be sought in the utilization of sewage.

First.—To prevent the pollution of rivers and streams; and

Second.—To so conduct the process of purification, that the resulting product may enrich the soil, and be remunerative for the labor employed and the capital invested in the undertaking.

The city of Worcester is located in a valley, through which run the waters of Mill Brook. The most populous portion of the city covers an area of from 2½ to 3 square miles. This area is occupied by from 30 to 35 thousand inhabitants, and also contains the larger share of all its varied manufacturing establishments. As an inevitable result of the location of the city, its sewage and drainage is conducted directly into Mill Brook, the contents of which are then discharged into and defile the Blackstone River.

Not much was done in the matter of building sewers in the city until 1867. In this year was commenced the walling and arching of Mill Brook, which work, at the present has been nearly completed for a distance of about two miles northerly from Cambridge Street.

In the same year was also commenced the building of a system of street sewers, to be used for drainage and sewerage, the outlet of all of which was made directly into the channel of Mill Brook. The construction of sewers has been continued year by year since its commencement. The total number of lineal feet now laid is 146,-068, or nearly 27¾ miles; so complete is the system that it includes every street in the district provided for. The depth at which they are laid ranges from 7 to 19 feet, the average depth being probably about 10 feet.

At this depth they are sufficiently low to drain all cellars on adjacent streets, and even underdrain many of them. In this location, they answer all the purposes of subsoil drains, sewers for the contiguous estates, and drains for conveying away the surface-water falling on the streets and adjacent lots.

As before stated, these drains all empty into Mill Brook.

The territory above given, on which is congregated the most densely inhabited portion of the city, has its sewerage concentrated by outlet mains and Mill Brook, where the brook crosses Cambridge Street. This point is only a few rods above the junction of Mill Brook with the Blackstone River.

This point of the intersection of Cambridge Street with Mill Brook, is the point of departure in conveying the sewage delivered by the sewers into Mill Brook, from the waters of the Blackstone River. It lies at the head of the flowage of the pond, formed by the dam across the Blackstone River at Quinsigamond village, so

called, in said city, and about 4,000 feet northerly of the iron works in said village.

The area drained by Mill Brook lying north of Cambridge Street, and with which we have now to deal, as connected with the sewers, is between $10\frac{1}{2}$ and 11 square miles. The quantity of water furnished by this area averages about 11,000,000 gallons per day. This amount is not regularly delivered by the brook because, during freshets, large quantities are carried off in a short space of time, after which freshets the constant flow is much below the annual average.

During the summer of 1871, the flow of Mill Brook was gauged for seventy-nine days, and its average during this time was found to be 4,198,000 gallons per day. From April to December, this quantity may be taken as the average dry-weather flow; when the stream is swollen by freshets or rains, the quantity would probably average from two to ten times as much as this measurement.

Taking the dry-weather flow as 4,000,000 gallons, we have 533,-333 cubic feet, a quantity sufficient to flow $12\frac{1}{4}$ acres of land one foot deep, or 147 acres one inch every twenty-four hours. To deal with this quantity, would equal 365 inches on 147 acres per annum, or $7\frac{6}{10}$ times the average annual rainfall in the city, as derived from the records kept at the State Lunatic Hospital. This quantity is far larger than could be dealt with by any process of precipitation or irrigation, at the commencement of any scheme of utilization.

After the accumulation of large experience, this quantity or even a larger might be successfully treated and purified.

In the fall of 1871, two measurements were made of the quantity of water discharged into Mill Brook from the sewers, in what may be termed the dry-weather days.

From this investigation it appeared, that for a larger part of the time, the amount to be dealt with might be placed at 1,500,000 gallons. From this estimate is excluded Pine Meadow and Bear Brooks, except at such time as the drainage by natural flow is reduced to a minimum.

This quantity may be taken as the sewage proper of the town at the present time, diluted with such subsoil drainage as is constantly finding its way into the sewers in the several districts. In two districts this subsoil drainage amounts to the largest part of the contents delivered by the sewers.

This subsoil drainage must always be included in the sewage, so long as the present system of sewers is maintained.

No accurate measurements have ever been made to determine the quantity of water drawn from the aqueduct in the city.

From such observations as have been made upon that question, the inference has been drawn, that the average quantity daily used, is at present between 2½ and 3 millions gallons. As has been before stated, the quantity of sewage to be dealt with in any system of utilization cannot be less than 1,500,000 gallons. To separate this from the ordinary flow of Mill Brook, is the first and most obvious problem.

It is apparent that this division can only be effected on such days as those in which the normal flow is unaffected by storms or rains.

The extension of the Piedmont sewer from its present outlet to Cambridge Street, will deliver the sewage from a little less than a square mile of this territory, into Mill Brook, at the point where its interception from entering and conveyance away from the Blackstone River must commence. Southerly and south-westerly of Piedmont Street district lies a district included in the territory under consideration, not yet provided with sewers; whenever this district is sewered, the outlet may be connected with the Southbridge-Street line, or may teminate separately at Cambridge Street. For these two districts, the separation of the ordinary dry-weather flow from Mill Brook is a problem of easy solution.

To collect the ordinary sewage from the twenty-nine sewers now entering Mill Brook, north of Cambridge Street, and make provision for future sewers, is a requirement less easy to fulfil.

To make this division the following plan is proposed:

The paving of the walling and arching of Mill Brook is laid on a curve or segment of a circle, the versed sine of which falls about two feet below the springing line of the arch on the skewbacks. The entrances of the sewers are made over the skewbacks, and above the springing line of the arch. This form of construction permits the laying of a cast-iron pipe in the centre of the canal, in such a position that branches may be laid from this central main to each sewer in succession, of sufficient size to take the normal sewage into this main separating-pipe. It would be necessary to extend this pipe from Cambridge Street to Lincoln Square, in the first instance, leaving it for future extensions northerly, as sewers should be laid for those districts.

The size of the pipe laid in the centre of the canal would be from twenty to thirty inches in diameter, and as it has to bear no large internal pressure, if of iron, may be cast as thin as practicable. Its fixtures would only be a suitable number of manholes, placed at convenient distances, with covers fitted in place, so as to be easily removed, for its inspection internally and the removal of such accumulation of sediment, as might be deposited therein; the side connections with the several sewers, to be made by lateral pipes of

suitable size to convey to the main the normal sewage contents of each sewer; each of these laterals to be fitted with a self-closing gate at its open end, so arranged as to be closed instantly when any amount of water should come from the sewer, as in a storm or rain, above the normal amount gauged by the setting of the gate.

The foregoing is a brief description of the arrangement proposed, for dividing the dry-weather sewage from the ordinary flow of the stream. It cannot be made clearly intelligible in all its details, without the aid of plans, but, undoubtedly, sufficient has been said to convey a general idea of its practicability.

Having collected the sewage as above described, at a point at Cambridge Street, it is now in position to be conveyed away separately. This can be done by building a conduit of suitable size running southerly about 4,000 feet, to the head of the old Blackstone Canal south of Millbury Street in the village of Quinsigamond. From Cambridge Street to the old canal, the fall is sufficient to allow the sewage to be discharged above the surface of its waters. This canal is 1,800 feet in length and about thirty feet wide, and four feet deep as originally built. It may be cleared out and fitted for a settling basin, for the grosser matters brought by the sewers, which may be removed from time to time, or it might be arranged to be used for any precipitating process which promises a remunerative return for the expense of working it. From this canal, water may be drawn to a limited extent and used for the purpose of irrigation. From this canal may be commenced conducting-pipes, laid on the declivity of the sloping hill-sides as we go southerly, for the purpose of conveying the sewage to land on which it may be used for irrigation or purification by filtration. The valley of the river as it leaves the end of the old canal lies very nearly south.

It has been examined as far down as the Greenwood Mills in Millbury, a distance of about two miles below where the sewage would leave the canal.

On the east side of the valley a conducting-pipe could be commenced at once and be continued on the side-hill to the Mills, and doubtless far beyond, without any obstruction in the form of ravines or valleys, and be in such a position as to advantageously deliver its contents upon land at all points as it progresses.

To reach the westerly slope of the valley a viaduct about 700 feet long would be required to convey it over the Blackstone River; when this point is reached the irrigating conduit may be carried as far upon the west as upon the east side of the valley, and have the same useful location as would that upon the east side.

From the old canal to Greenwood's Mills there are about 800

acres of land that would be covered by the extension of the two main conduits above specified.

This area is not the limit which may be reached by an extension of the main lines in the valley below the Greenwood Mills; and by elevating the sewage by steam or by *wind-mills*, the area on to which this sewage may be carried could easily be enlarged to 2,000 acres.

The soil is varied in its character; that along the river-banks being the ordinary sandy intervale land so common in New England. Of this the amount is quite limited.

On the west of the river there is much light sandy and gravelly soil, now nearly worthless for agricultural purposes.

Some of these flats lie some twelve to twenty feet above the intervales, and would form a fine opportunity to test what is called the intermittent system of "Cubic Filtration" for the purification of the sewage, so much advocated by some English engineers. On the west there is one swamp of about one hundred acres that would afford a good opportunity to try winter flushing to a large extent, in order to test its value on a summer crop of grass on the same ground. On the east, much of the soil of the valley is a cold, clayey, hard-pan, forming good lands for grass, while the western side is much the best for the cultivation of all the varied vegetables, cereals, and small fruits which might be attempted with profit.

The land is now in every varied condition, from the tangled bramble-bush pasture or wooded area, to the cultivated mowing and tillage field. To be used for any purpose like that indicated, it would need special preparation by clearing, under-draining, and constructing proper conduits to convey and flush the sewage over the ground, with proper drains to carry to the river the superfluous water.

To bring this whole area into proper condition to be used efficiently for this purpose would be a large undertaking, and one to be worked out step by step during several years, profiting each year in extending the work by the experience gained in its predecessors.

In this way, any large mistake might be avoided that would be risked were it attempted to put the whole land in a proper condition before anything was done in the way of irrigation for useful purposes.

It is not now intended to go into the minute details as to the mode of procedure that should be followed to carry out a work of this kind, or to indicate what is deemed best as to the manner of constructing the various kinds of appliances needed to insure economy of transport and delivery of the sewage, and success in its application to the land.

The only aim has been to point out the possibility, by indicating briefly the ground that might be used for the purposes of irrigation or filtration, and to state in brief the manner of collecting and diverting these polluting matters from the Blackstone River.

No attempt has been made to specify the details of any system, or even arrange any such system, beyond a mere outline of its main features. These details are left for a more careful study, and as a proper matter, to be arranged and adopted after the attainment of some experience.

The value of irrigation has long been known to the practical agriculturist.

Its history is almost coeval with that of the race.

There can be no question as to the value of sewage, when used properly, as an agent in the promotion of the growth of every crop useful to man. Sewage has been thus successfully applied in England and on the Continent. In this country there is little or no practical experience to guide us in an undertaking of this kind.

To adopt European methods without modification would be of doubtful utility, our climate, soil and various other conditions are so different from theirs. Success in enterprises of this kind in this country must be based upon home experience, but when this is once attained, every inland village, city and manufactory will regard it as a useful addition to their system of water-supply and sewerage.

The elements of success in the utilization of sewage, are the same as those that go to make up success in any calling in life.

For each enterprise there must be one responsible manager, and he must study the means used in all their detail, and the results attained in all their variety, as carefully as the successful merchant studies the wants, wishes and tastes of his customers, and note processes as assiduously as the merchant consults from day to day the prices-current of goods in the market. He must be as wide-awake to note every fact, and determine its relation in the chain of cause and effect in the results taking place under his observation, as is the banker to ascertain the fluctuating market-price of stocks and of gold, and the rise and fall in the rate of interest. When thus pursued enthusiastically, success is as sure in this undertaking as in any manufacturing or mercantile enterprise whatever.

When the plan has been devised, and its details arranged and its operations set in motion, all oversight must not end here, any more than care for power in the manufactory ends with the placing of the steam-boilers and the engine. In fact, care begins with their use, and good results are only attained by the most intelligent watching and caring for all the processes concerned in the result.

So in the utilization of sewage, the manager's system of delivery-pipes is his engine, his gates the regulators of his work, the sewage the fuel that feeds the growing crop, and it is his sole business to furnish that fuel in just that quantity, and at the proper time, to produce the largest fruitage from that crop.

By this mode of procedure it will soon create a science of its own.

When this science shall have been thus carefully collated from actual experience, it will then safely pilot all who would commence works of this kind to a sure and successful accomplishment of their enterprises.

PHINEHAS BALL.

WORCESTER, December 31, 1872.

Appendix B.

102 Chauncy Street, Boston,
October 10, 1872.

George Derby, M. D., *Secretary of the State Board of Health.*

I present to you herewith, in accordance with your request, a list of the ponds or lakes in the State whose areas exceed ten acres. It is arranged in tabular form by counties and towns, and gives, from the best attainable authorities, the names of the ponds and lakes, their location, areas and outlets.

The areas have been computed generally upon the county maps, by means of an Amstler's Planimeter, and have been verified by independent repetitions. It should be stated here, however, that no systematic instrumental survey of the waters of the State has been made. So far as my knowledge extends the representations of ponds, lakes, rivers and streams upon existing maps have generally been made by estimating distances from the travelled roads by the eye, aided by some rude triangulation, with an ordinary surveyor's compass. This of course gives only a rough approximation to accuracy, which, accordingly, is all that can be claimed for the table herewith presented.

It is greatly to be desired that an accurate plane-table survey of the entire State, giving contour lines, etc., should be made in connection with the careful triangulation which was carried through the State some years ago by Mr. Borden.

In sanitary investigations such a survey would be eminently useful, the elevation of the ground, distribution of water, etc., entering as important elements into these investigations, while for all engineering operations, such as the water-supply of towns and the construction of railroads and other public works, its value would far exceed its cost, as has been shown by experience in those States of Europe where surveys of this kind have been made.

Very respectfully yours,

H. F. WALLING.

Berkshire County (Total No. of acres, 6,226).

Name.	Area in acres.	Outlet.
Florida.		
North Pond,	12	Cold River.
Hancock.		
Mountain Pond,	20	– –
Lanesborough.		
Pontoosuc Lake,	313	Housatonic Riv.
Pittsfield.		
Lake Onota,	555	
Lily Pond,	20	Housatonic Riv.
Silver Lake,	20	
Sylvan Lake,	10	
Savoy.		
South Pond,	28	Cold River.
Windsor.		
Windsor Pond,	107	Westfield River.
Hinsdale.		
Reservoir,	54	Housatonic Riv.
Peru.		
Mill Pond, near the centre,	20	Fuller Brook.
Richmond.		
Richmond Pond,	178	Scott Brook.
Washington.		
West Pond,	75	Roaring Brook.
Clapp Pond,	10	
Ashley Lake,	38	Ashley Brook,
Muddy Pond,	50	– –
Benson Pond,	27	W. Br. of Westfield River.
Basin Pond,	67	Housatonic Riv.
West Stockbridge.		
Cranberry Pond,	15	
Crane Pond,	33	
Shaker Mill Pond,	70	Williams River.
Pond near Richmond Line,	22	
Mill Pond, Williamsville,	13	
Stockbridge.		
Lake Mahkenac,	250	
Mountain Mirror,	45	Housatonic Riv.
Mohawk Lake,	23	
Agawam Lake,	25	
Lee.		
Laurel Lake,	152	
Goose Pond,	225	Housatonic Riv.
Long Pond,	62	
Becket.		
Greenwater Pond,	100	Housatonic Riv.
Yokum Pond,	118	
Wheeler Reservoir,	100	W. Br. Westfield River.
Rudd Pond,	96	
Centre Lake,	163	
Horn Pond,	21	Walker Brook.
Ward Pond,	22	Farmington Riv.
Shaw Pond,	100	
Egremont.		
Winchel Pond,	140	Green River,
Marsh Pond,	72	Willard's Br'k.
Great Barrington.		
Pond near centre,	26	Housatonic Riv.
Long Lake,	96	Seekonk River.
Monterey.		
Six-Mile Pond,	344	Mill River.
Brewer Pond,	250	
Otis.		
Thomas Pond,	90	Farmington Riv.
Pond below Thomas Pond,	39	
Hayes Pond,	63	Hop Brook.
Pond in Otis Centre,	24	
White-Lily Pond,	50	
Mill Pond west of White-Lily Pond,	25	
Haley Pond,	18	
Great Lake,	335	
Parish Pond,	42	Farmington Riv.
Rand Pond,	235	
Pond above Rand Pond,	20	
Pond below Rand Pond,	95	
Larkum Pond,	38	
Mount Washington.		
Gilder Pond,	53	Gilder Brook.
Lee Pond,	11	Lee Pond Br'k.
Plantain Pond,	120	– –
Sheffield.		
Harmon Pond,	20	
Spur Lake,	20	
Davis Pond,	35	Williams Br'k.
Pond north of Davis Pond,	14	
Pond near Sheffield Plain,	93	
Three-Mile Lake,	104	Housatonic Riv.
New Marlborough.		
Juniper Pond,	20	Mill River.
Harmon Pond,	33	Umpachina Riv.
East Pond,	104	– –
Sandisfield,		
Pond near West Otis,	18	
Upper Spectacle Pond,	78	Clam River.
Lower Spectacle Pond,	113	
Reservoir,	53	
Simons Pond,	76	Farmington Riv.

Franklin County (Total No. of acres, 2,184).

Name.	Area in acres.	Outlet.
Rowe.		
Reservoir Pond,	75	Pelham Brook.
Coleraine.		
Pond in Foundry Village,	15	North River.
Leyden.		
Greenfield Aqueduct Pond,	13	Buddington Creek.
Northfield.		
Pond on Erving Line,	16	Keyup Brook.

HAMPSHIRE COUNTY—Concluded.

NAME.	Area in acres.	Outlet.
Three contiguous ponds west of River,	16 15 13	Bennett's Br'k.
Pond near Cragg Mountain,	15	Keyup Brook.
Gill.		
Pond near centre,	17	Unadilla Brook.
Otter Pond,	14	Otter Pond Brk.
Orange.		
North Pond,	78	Middle Branch [Swift River.
Pond east of North Orange,	66	Tully River.
Pond E. of same,	40	
Warwick.		
Pond near New Hampshire line,	15	Valley Brook.
Bass Reservoir,	50	Mill Brook.
Pond southwest of the same,	57	
Pond northeast of the Centre,	11	Orcutt's Brook.
Pond north of the same,	15	
Hastings' Pond,	27	
Pond east of Hastings' Pond,	26	
Upper Pond on Tully Brook,	30	Tully River.
Lower Pond on Tully Brook,	10	
Moore Pond,	25	Moss Brook.
Delva's Pond,	20	
Pond west of the same,	60	
Long Pond,	84	
Pond east of Long Pond,	118	
Pond near southeast corner,	56	Orcutt's Brook.
Ashfield.		
Great Pond,	60	South River.
Williams Pond,	26	Swift River.
Pond south part,	13	
Conway.		
City Pond,	25	Swift River.
Montague.		
Green Pond,	13	None.
Wendell.		
Mill Pond in west part,	15	Miller's River.
Wicket Pond,	83	
Pond in northeast part,	15	
New Salem.		
Reservoir in north-east corner,	320	Miller's River.
Spectacle Pond,	90	
Hacker's Pond,	15	
Thompson's Pond,	235	Middle Branch Swift River.
Pond above the same,	30	
Nance Lake,	13	None.
Millington Mill Pond,	12	Middle Branch Swift River.
Hop Brook Pond,	20	
Sunderland.		
Cranberry Pond,	22	Cranberry Br'k.
Leverett.		
Fish Pond,	33	Roaring Brook.
Shutesbury.		
Lock's Pond,	127	Saw-Mill River.
Pond near Dudleyville,	20	

HAMPSHIRE COUNTY (Total No. of acres, 2,282).

NAME.	Area in acres.	Outlet.
Plainfield.		
Plainfield Pond,	45	Chickley's Riv.
Crooked Pond,	21	Westfield River.
Pond on Hawley line,	25	Chickley's Riv.
Goshen.		
Lily Pond,	57	Swift River.
Reservoir,	100	W. Br. Mill Riv.
Dresser Pond,	44	E. Br. Westfield River.
Middlefield.		
Pond near centre,	12	W.Br.Westfield [River.
Chesterfield.		
Burnell's Pond,	37	Dead Br. West- [field Riv.
Hatfield.		
Pond in west part,	20	Mill River.
Two ponds in north-east part,	17 23	Connecticut Riv.
Hadley.		
Pond, southeast of the village,	40	Fort River.
Pond, east of North Hadley,	48	Mill River.
Pond, north of Plainville,	49	
Amherst.		
Pond in North Amherst,	15	Mill River.
Pond at Mill Valley,	23	Fort River.
Pond in east part,	11	None.
Prescott.		
Gibbs Pond,	22	Middle Branch Swift River.
Hackmetack Pond,	15	
Mill Pond, northwest of same,	13	
Large Pond and Swift River,	154	Swift River.
Pond above the same,	17	
Huntington.		
Norwich Pond,	128	E. Br. Westfield [River.
Westhampton.		
Pond in south part,	11	N. Br. Manham [River.
Hanging Mountain Pond,	10	Roberts Brook.
Southampton.		
Hampton Pond,	197	Pond Brook.
Northampton.		
Pond, near Ox Bow,	80	Connecticut Riv.

HAMPSHIRE COUNTY—Concluded.

NAME.	Area in acres.	Outlet.
Easthampton.		
Upper Mill-Pond,	53	Manhan River.
Lower Mill-Pond,	35	
South Hadley.		
Pond in north part,	16	Elmers Brook.
Upper Pond, in S. Hadley Village,	12	Stony Brook.
Lower Pond in South Hadley Village.	16	
Taylor Pond,	15	None.
Granby.		
Pond, north of Centre,	30	Batchelder Br'k.
Pond, near Belchertown line,	115	
Belchertown.		
Pond in north part,	17	Jabish River.
Middle Pond,	40	Batchelder's Brook.
Lower Pond,	90	

NAME.	Area in acres.	Outlet.
Mill Pond, near Granby line,	10	Batchelder's Br.
Mill Pond, southeast from R. R. station,	22	Jabish River.
Enfield.		
Train Pond,	13	Beaver Brook.
Morton Pond,	20	
Greenwich.		
Bullhead Pond,	23	None.
Curtis Pond,	155	Middle Branch Swift River.
Luce Pond,	124	
Pond in Greenwich Village,	30	East Br'ch Swift River.
West Pond,	94	
Flask Pond,	18	Middle Branch Swift River.
Davis Pond,	100	East Br'ch Swift River.

HAMPDEN COUNTY (Total No. of acres, 4,148).

Blandford.		
North Meadow Pond	80	Westfield Little River.
Long Pond,	150	Muddy Pond Brook.
Blair Pond,	215	Westfield Little River.
Russell.		
Hazzard's Pond,	60	Westfield River.
Montgomery.		
Shatterack Pond,	17	Shatterack Br'k.
Westfield.		
Buck Pond,	30	Sackett's Br'k.
Horse Pond,	45	
Holyoke.		
Hitchcock Pond,	58	Block Brook.
Ashley's Pond,	96	
Chicopee.		
Slipe Pond,	114	None.
Slabbery Pond,	69	
Smooth Pond,	10	
Springfield.		
Pond at Indian Orchard,	15	None.
Five-Mile Pond,	96	
Pond, west of the same,	26	
Loon Pond,	18	North Br'ch Mill [Riv.
Lake Como,	10	None.
Water-Shop Pond,	328	Mill River.
Bass Pond,	24	None.
Ludlow.		
Pond in north part,	13	Stony Brook.
Pond in west part,	11	None.
Pickerel Pond,	11	
Chapin's Pond,	45	
Woods' Pond,	31	Chicopee River.
Pond east of Woods' Pond,	18	None.
Mill Pond below Jenksville,	75	Chicopee River.

Palmer.		
North Pattaquattic Pond,	15	Ware River.
South Pattaquattic Pond,	50	
Pond west of Thorndike,	13	None.
Calkins Pond,	32	Ware River.
Tolland.		
Messenger or Cotton Pond,	580	Farmington Riv.
Noyes Pond,	276	Hubbard's Riv.
Hall's Pond,	33	
Cranberry Pond,	17	Slocum Brook.
Granville.		
Brack Pond,	28	– –
Pond east of the same,	12	Hubbard's Riv.
Southwick.		
Congamuck Pond,	589	Great Brook.
Agawam.		
Mill Pond, southwest part,	11	Still Brook.
Mill Pond, southeast part,	11	Connecticut Riv.
Wilbraham.		
Spectacle Ponds,	20	None.
Nine-Mile Pond,	36	
Pond in centre of Wilbraham,	30	South Br'ch Mill River.
Monson.		
Pond in centre,	11	Quabaug River.
Brimfield.		
Baker's Pond,	16	Quinebaug Riv.
Grape Pond,	95	Town Brook.
Little Alum Pond,	134	Quinebaug Riv.
Pond, southwest of centre,	13	Mill Brook.
Wales.		
Wales Pond,	66	Mill River.
Holland.		
Holland Pond,	64	Quinebaug Riv.
Hamilton Reservoir,	331	

WORCESTER COUNTY (Total No. of acres, 25,007).

NAME.	Area in acres.	Outlet.
Royalston.		
Long Pond,	80	Tully River.
Pond, east of the centre,	25	Lawrence Br'k.
Pond, south the same,	23	
Winchendon.		
Pond at Bullardsville,	20	Miller's River.
Part of Monomonac Pond,	114	
Upper Mill Pond, North Village,	81	
Pond on Ashburnh'm line,	100	
Pond, southwest of the same,	44	
Pond at New Boston,	87	
Pond, southeast of the same,	54	Otter River.
Reservoir, south p'rt,	122	
Ashburnham.		
Lower Naukeag Pond,	150	Miller's River.
Upper Naukeag Pond,	302	
Pond in northwest part,	16	Bear Meadow Br'k.
Reservoir near Mt. Hunger,	75	Phillips Br'k.
Pond northwest of the same,	16	
Stodge Meadow Br'k,	58	– –
Ward Pond,	54	– –
Watatic Pond,	52	– –
Reservoir on Gardn'r line,	300	Whitman's Riv.
Pond, north of the same,	23	Miller's River.
Pond at Ashburnh'm Junction,	16	Whitman's Riv.
Pond at South Ashburnham,	28	
Athol.		
Babcock Pond,	44	Miller's River.
Pond, south of Athol Centre,	25	
White Pond,	100	
Pond south of the same,	65	
Phillipston.		
Reservoir on line of Athol,	130	Miller's River.
Pond, east of the same,	30	Beaver Brook.
Phillipston Pond,	202	Burn-Shirt Riv.
Pond, northeast of the same,	130	
Templeton.		
Pond at Baldwinsville,	14	Otter River.
Upper Pond, east of Brook's Village,	26	Trout-Brook.
Middle Pond, east of Brooks Village,	25	
Lower Pond, east of Brooks Village,	25	
Pond at East Templeton,	96	Otter River.
Pond at Partridgeville,	56	
Brown's Pond,	23	Burn-Shirt Riv.

NAME.	Area in acres.	Outlet.
Gardner.		
Pond, west of Gard'r Centre,	38	Otter River.
Pond, north of the above,	25	
Crystal Lake,	216	
Kendall Pond,	44	
Pond north of Cryst'l Lake,	17	
Snake Pond,	18	None.
South Gardner Reservoir,	77	Otter River.
Mill Pond, South Gardner,	30	
Pond, west of the above,	22	
Westminster.		
Muddy Pond,	78	Whitman's Riv.
Pond near South Gardn'r Reservoir,	31	Otter River.
Coolidge & Adams' Reservoir,	70	Whitman's Riv.
Merriam's Reservoir,	31	
Meeting-house Pond,	172	
Wachusett Pond,	250	
Grassy Pond,	26	
Fitchburg.		
Pond, southwest cor.,	22	Whitman's Riv.
Pond at Rockville,	24	Phillips Brook.
Lunenburg.		
Unkechewhalon P'd,	177	Catacoonamug River.
Massapog Pond,	80	
Catacoonamug P'nd,	370	
Leominster.		
Reservoir,	508	Monoosnoc B'k.
Rocky Pond,	45	
Mill Pond at centre,	19	
Pond in southwest corner,	45	Justice Brook.
Petersham.		
Reservoir on Athol line,	136	Miller's River.
Reservoir, south of above,	175	East Br. Fever [Brook.
Dana.		
Neeseponsett Pond,	118	Fever Brook.
Pond, south of the above,	40	
Sunk Pond,	15	East Br. Swift River.
Pottapaug Pond,	160	
Hubbardston.		
Pond, west corner of Hubbardston,	38	Burn-Shirt Riv.
Natty Pond,	40	Natty P'nd Br'k.
Pond, south of Natty Pond,	17	
Pond in north corner of Hubbardston,	40	Otter River.
Pond, southeast of the above,	47	Ware River.
Reservoir, near Westminster line,	90	
Pond in east corner,	37	
Moosehorn Pond,	160	
Asnyconic Pond,	238	
Princeton.		
Pond in north part,	66	Keyes Brook.

WORCESTER COUNTY—Continued.

Name.	Area in acres.	Outlet.
Pond in east part, .	17	Still River.
Quinepoxet Pond, .	75	Quinepoxet Riv.
Sterling.		
Pond in northwest corner, . . .	23	Justice Brook.
Pond, northeast of centre, . . .	10	Bailey Brook.
Waushaccum Pond,	180	
East Waushaccum Pond, . . .	190	South Branch Nashua River.
Fitch Pond, . .	11	
Lancaster.		
White's Pond, . .	62	North Branch Nashua River.
Turner's Pond, .	29	
Fort Pond, . .	118	None.
Little Spectacle P'd,	23	
Spectacle Pond, .	94	
Oak Hill Pond, .	33	North Branch Nashua River.
Cranberry Pond, .	22	
Harvard.		
Hill Pond, . .	33	None,
Robbins Pond, . .	11	Nashua River.
Black Pond, . .	10	Beaver Brook.
Bare Hill, . . .	320	Nonecanicus Brook.
Bolton.		
South Pond, . .	39	Assabet River.
West Pond, . .	42	Assabet Brook.
Berlin.		
Gates Pond, . .	16	
Pond at South Berlin, ...	19	Assabet River.
Hardwick.		
Mill Pond, in east cor.	18	Pine Hill Brook.
Pond, northwest of the above, . .	20	Moose Brook.
Muddy Pond, . .	202	
Pond, north of the above, . . .	26	Muddy Brook.
Pond, south of Hardwick Centre, . .	15	Ware River.
Barre.		
Reservoir, . .	200	
Pond, southeast of centre, . . .	20	Ware River.
Two Mill Ponds, in east part, . .	20 20	Burn-Shirt Riv.
New Braintree.		
Two contiguous p'ds near the centre, .	94 75	Sucker Brook.
Oakham.		
Muddy Pond, . .	75	Muddy P'nd B'k.
Pond, southeast of centre, . . .	25	Five-Mile River.
Browning Pond, .	140	Seven-Mile Riv.
Rutland.		
Pond in north part, .	22	Ware River.
Pond in west of the centre, . . .	135	Long Pond Br'k.
Musquapog Pond, .	110	Quinepoxet Riv.
Long Pond, . .	160	Long Pond Br'k.
Demon Pond, . .	138	
Turkey Hill Pond, .	83	Turkey Hill B'k.
Paxton.		
Pond in west part, .	40	Turkey Hill B'k.

Name.	Area in acres.	Outlet.
Asnybumskitt P'd,	50	Asnybumskitt Brook.
Bottomly Pond, .	124	Kettle Brook.
Upper Reservoir, .	25	
Holden.		
Pond, west of Pine Hill, ...	77	
Pond at Eagleville, .	90	Asnybumskitt Brook.
Pond, southwest of the above. . .	74	
Pond, northwest of Eagleville, . .	18	
Pond at Quinepoxet Village, . . .	28	
Rutland Pond, . .	24	Quinepoxet Riv.
Pond at Unionville, .	20	
Pond at Chaffenville,	92	
Pond at southwest corner, . . .	100	Tatrick Brook.
Boylston.		
Mill Pond, north p'rt,	50	
Pond, west of Boylston Centre, . .	34	Nashua River.
Pond, south of Boylston Centre, . .	72	Muddy Brook.
Rocky Pond, . . .	86	Cold Harbor Brook.
Sewal Pond, . .	36	Quinsigamond River.
Pout Pond, . .	16	None.
West Boylston.		
Pond in north part, .	14	Shaker Brook.
Clinton.		
Ponds, west of centre,	133	Nashua River.
Sandy Pond, . .	75	
Clam-Shell Pond, .	35	None.
Pond, west of above,	51	Nashua River.
West Brookfield.		
Wickaboag Pond, .	323	Quabaug River.
North Brookfield.		
Brooks Pond, . .	178	Five-Mile River.
Horse Pond, . .	42	
Pond in northwest part, ...	11	Sucker Brook.
Furnace Pond, . .	305	Five-Mile River.
Brookfield.		
Mud Pond, . .	10	Moore's Brook.
Mill Pond, southeast of Furnace Pond, .	13	Seven-Mile Riv.
Podunk Pond, . .	508	
Pond, east of the above, . . .	42	Quabaug River.
South Pond, . .	340	
Pond, northwest of the above, . .	16	
Pond, west of Podunk Pond, . .	30	Mason Brook.
Pond, near West Brookfield line, .	32	Quabaug River.
Spencer.		
Pond in northeast corner, . . .	24	TurkeyMill B'k.
Pond in Wire Vil'ge,	18	
Pond, south of Hillsville, . . .	25	
Moose Pond, . .	52	Seven-Mile Riv.
Pond, southwest from centre, . .	12	

WORCESTER COUNTY—Continued.

NAME.	Area in acres.	Outlet.
Cranberry Meadow Pond,	107	Cranberry Riv.
Stiles Reservoir,	390	French River.
Leicester.		
Shaw Pond,	126	Turkey Hill B'k.
Grosvenor Reserv'r,	50	Town Meadow Brook.
Pond, southeast of the above,	68	
Pond on Paxton line,	10	
Mann and Marshall Reservoir,	30	
Pond, southeast of the above,	10	
Worcester City Reservoir,	115	Kettle Brook.
Pond, southwest of the above,	43	
Lower Pond, Cherry Valley,	16	
Middle Pond, Cherry Valley,	22	
Henshaw's Pond,	69	French River.
Burn-Coat Pond,	157	Burn-Coat Br'k.
Cedar Meadow P'nd,	233	
Greenville Reserv'r,	55	French River.
Pond, southwest of centre,	13	Town Meadow [Br'k.
Rochdale Pond,	82	French River.
Worcester.		
Pond in northwest part,	32	
Pond, southeast of Tatnick Village,	35	Tatnick Brook.
Pond, south of the above,	14	
North Pond,	170	Mill Brook.
Pond, south of North Pond,	17	
Coe's Reservoir,	122	Tatnick Brook.
Pond in southwest corner,	47	Kettle Brook.
Pond, south of New Worcester,	78	
Pond, south of South Worcester,	16	Blackstone Riv.
Pond in Quinsigam'd Village,	24	
Shrewsbury.		
Newton Pond,	33	
Quinsigamond Pond,	1,051	
Pond, southeast of Newton Pond,	66	Quinsigamond River.
Jordan Pond,	27	
Pond, northeast of the above,	15	
Northborough.		
Solomon Pond,	20	None.
Bartlett Pond,	58	Stirrup Brook.
Little Chauncey P'd,	42	
Pond in southwest part,	23	Assabet River.
Westborough.		
Chauncey Pond,	185	Stirrup Brook.
Hobomoco Pond,	31	Assabet River.
Cedar Swamp Pond,	15	Sudbury River.
Southborough.		
Brigham Pond,	18	Stony Brook.
Pond, north of Fayville,	31	

NAME.	Area in acres.	Outlet.
Pond, southwest of Southville,	18	Sudbury River.
Sturbridge.		
Alum Pond,	282	
Long Pond,	65	
Cedar Pond,	182	Quinebaug Riv.
Pond, north of the above,	32	
Walker Pond,	152	Hobbs Brook.
Lead-Mine Pond,	163	Lead-Mine B'k.
Pond, southeast of the above,	22	Hamant Brook.
Southbridge.		
Pond at Globe Vil'ge,	38	Quinebaug Riv.
Pond, southeast cor.,	17	– –
Charlton.		
Hicks Pond,	120	
Pond, west of Charlton City,	25	Cady Brook.
Pond, north of the above,	15	
Lower Pond, Milward,	34	Little River.
Upper Pond, Milward,	16	
Pond in west part,	20	Globe Brook.
Warren Pond,	58	Quinebaug Riv.
South Charlton Reservoir,	187	
Pond, east of the above,	12	Little River.
Slater's Reservoir,	90	
Oxford.		
Pond at Larned Village,	30	French River.
Pond at North Oxford Station,	48	
Pond, southwest of the above,	16	None.
Upper Pond, Hodge's Village,	23	
Lower Pond, Hodge's Village,	14	
Pond, southeast of centre,	39	
Bugg Pond,	11	French River.
Pond, near central turnpike,	37	
Pond, northeast of above,	58	
Auburn.		
Stoneville Reservoir,	48	Kettle Brook,
Pond, northeast of the above,	30	
Pond, northeast of Stoneville,	175	
Pond, north of centre,	28	Blackstone Riv.
Pond, east of centre,	30	
Eddy Pond,	40	Dark Brook.
Millbury.		
Dorothea Pond,	125	Blackstone Riv.
Pond, northwest of Millbury Village,	28	
Lower Mill Pond, Bramanville,	12	Singletary Br'k.
Ramshorn Pond,	145	Ramshorn Br'k.
Sutton.		
Singletary Pond,	440	Singletary Br'k.
Two ponds, southwest of above,	28 18	

WORCESTER COUNTY—Concluded.

NAME.	Area in acres.	Outlet.
Sibley Reservoir, .	61	Cold Spring B'k.
Pond in Wilkinsonville, . . .	32	Blackstone Riv.
Pond, north of the above, . . .	31	
Pleasantdale Pond, .	77	Cold Spring B'k.
Clark's Reservoir, .	53	
Pond at West Sutton,	18	Mumford River.
Manchaug Pond, .	333	
Pond, north of the above, . . .	22	
Pond, southwest of Manchaug Village,	136	
Pond, north of Manchaug Village, .	30	
Grafton.		
Goddard Pond, .	105	Quinsigamond [River.
Pond, northeast part,	20	Misquo Brook.
Pond, southeast part,	40	
Northbridge.		
Pond at Rockdale, .	63	Blackstone Riv.
Pond, southeast of the above, . .	24	
Whitinsville Pond, .	323	Mumford River.
Swan Pond, . .	41	
Pond at Linwood, .	30	
Upton.		
Pond at West Upton,	40	West River.
Zachary Pond, . .	24	
Pratt's Pond, . .	25	Centre Brook.
Milford.		
Ponds, on line of Upton, . . .	67	Mill River.
Cedar Swamp Pond,	174	Charles River.
Pond on line of Bellingham, . .	65	
Mendon.		
Taft's Pond, . .	160	Blackstone Riv.
Dudley.		
Gore Pond, . .	224	Little River.
Pierpont Meadow Pond, . . .	92	
Hayden Pond, . .	50	French River.
Pond, south of the above, . . .	26	
Larned Pond, . .	65	
Pond, northwest of the above, . .	28	
Peter Pond, . .	65	
Pond in Merino Village, . . .	138	
Pond, southeast cor.,	16	
Webster.		
Nipmuck Pond, .	24	Sucker Brook.
Kingsbury Pond, .	40	
Chaubunagungamaug Pond, . . .	1,230	French River.
Douglas.		
Reservoir, . . .	470	Mumford River.
Wallis Pond, . .	47	
Upper Pond, in East Douglas, .	17	
Bad Luck Pond, .	106	
Baiting Pond, . .	15	– –
Wallum Pond, . .	150	– –
Uxbridge.		
Reservoir, northwest part, . . .	186	Mumford River.
Pond at Uxbridge Village, . .	18	
Pond at North Uxbridge, . . .	24	
Pond, northeast of above, . . .	30	Blackstone Riv.
Pond, northeast of Uxbridge Village,	20	
Pond at Ironstone, .	53	
Chocalog Pond, .	22	– –
Black Pond, . .	13	None.
Pout Pond, . .	13	West River.
Blackstone.		
Harris Pond, . .	106	Mill River.
Mill Pond at East Blackstone, . .	20	

MIDDLESEX COUNTY (Total No. of acres, 8,743).

NAME.	Area in acres.	Outlet.
Ashby.		
Reservoir, . .	87	Willard Brook.
Neesepogesuck P'ds,	22	Pearl Hill Br'k.
Townsend.		
Harbor Pond, . .	95	Squannacook River.
Pond, southwest of the above, . .	12	
Reservoir, . .	22	
Tyngsborough.		
Massapoag Pond, .	56	Salmon Brook.
Pond, south of the above, . . .	12	
Tyng's Pond, . .	228	Merrimac River.
Mud Pond, . .	46	
Dracut.		
Part of Long Pond, .	114	Beaver River,
Merrimac Mills P'nd,	12	Merrimac River.
Peters Pond, . .	104	
Shirley.		
Paper Mill Pond, .	44	Squannacook River.
Squannacook Pond,	13	
Dead Pond, . .	16	None.
Pond, northeast of the above, . .	22	Catacoonamug [River.
Ayer.		
Ames Plow Company's Pond, .	45	Nonacanicus Brook.
Sandy Pond, . .	80	
Pond, west of the above, . . .	115	
Long Pond, . . .	45	
Pond in southeast corner, . . .	10	Bennett's Br'k.
Groton.		
Martin's Pond, .	31	Martin's Pond [Brook.
Baddacook Pond, .	103	Baddacook B'k.
Whitney's Pond, .	71	Cow Pond Br'k.

MIDDLESEX COUNTY—Continued.

NAME.	Area in acres.	Outlet.
Knop's Pond,	55	Martin's Pond Brook.
Dick Pond,	55	None.
Westford.		
Sought-for Pond,	106	
Keyes Pond,	20	
Nabnassett Pond,	98	
Pond, west of the above,	13	Stony Brook.
Burge Pond,	22	
Forge Pond,	143	
Chelmsford.		
Newfield Pond,	80	Stony Brook.
Hart Pond,	105	River Meadow Brook.
Tewksbury.		
Long Pond,	43	Shawsheen Riv.
Round Pond,	28	Strongwater Brook.
Littleton.		
Spectacle Pond,	71	Stony Brook.
Pond, west of vil'ge,	40	Beaver Brook.
Long Pond,	78	Long Pond B'k.
Fort Pond,	104	
Nagog Pond,	220	Nashoba Br'k.
Boxborough.		
Withington Pond,	37	Assabet Brook.
Acton.		
Grassy Pond,	33	Long Pond B'k.
Pond in northeast part,	11	Nashoba Brook.
Pond, southeast p'rt,	10	None.
Concord.		
Bateman's Pond,	20	Assabet River.
White Pond,	53	Sudbury River.
Walden Pond,	80	None.
Fair Haven Bay,	60	Sudbury River.
Billerica.		
Winnings' Pond,	10	Concord River.
Nutting's Pond,	90	
Wilmington.		
Silver Lake,	37	Ipswich River.
Burlington.		
Pond in northeast corner,	10	Ipswich River.
Pond on line of Lexington,	10	Vine Brook.
Woburn.		
Pond, east of North Woburn,	31	
Pond at E. Woburn,	14	Mystic River.
Horn Pond,	91	
North Reading.		
Martin's Pond,	136	Martin's Brook.
Swan Pond,	86	Ipswich River.
Pond on Ipswich River,	23	
Wakefield.		
South Reading P'nd,	264	Saugus River.
Crystal Lake,	48	
Stow.		
Boon's Pond,	100	Assabet River.
Pond in the Assabet River,	283	

NAME.	Area in acres.	Outlet.
Hudson.		
White Pond,	46	Assabet River.
Marlborough.		
Fort Meadow Res'v'r,	250	Fort Meadow [Brook
Williams Pond,	100	Assabet River.
Maynard.		
Assabet Mill Pond,	19	Assabet River.
Puffer's Pond,	41	
Sudbury.		
Willis Pond,	74	Assabet River.
Bottomless Pond,	21	None.
Pond on Hop Brook,	13	Hop Brook.
Blandford Pond,	22	Wash Brook.
Pond, north of the above,	11	
Wayland.		
Pelham Pond,	75	Sudbury River.
Dudley Pond,	86	None.
Lincoln.		
Sandy Pond,	114	Stony Brook.
Two ponds in northeast part,	30	Hobbs Brook.
	20	None.
Beaver Pond,	112	Stony Brook.
Winchester.		
Winter Pond,	24	None.
Wedge Pond,	67	Mystic River.
Pond in northeast part,	15	
Stoneham.		
Doleful Pond,	13	Malden River.
Spot Pond,	220	
Malden.		
Pond in Malden Centre,	10	Malden River.
Melrose.		
Pond in centre,	30	Malden River.
Long Pond,	10	Saugus River.
Hopkinton.		
Whitehall Pond,	620	Sudbury River,
North Pond,	81	Mill River.
Holliston.		
Pond at East Vil'ge,	24	
Pond, southeast of the above,	14	Jar Brook.
Winthrop Pond,	125	
Ashland.		
Pond in west part,	16	
Pond in centre,	18	Sudbury River.
Pond, southeast of the above,	18	
Framingham.		
Farm Pond,	168	Sudbury River.
Learned's Pond,	42	None.
Gleason's Pond,	10	Steep Brook.
Shakum Pond,	93	
Sherborn.		
Farm Pond,	100	Charles River.
Natick.		
Lake Cochituate,	690	Cochituate Br'k.
Pickerel Pond,	10	Charles River.
Pond in east part,	11	

MIDDLESEX COUNTY—Concluded.

Name.	Area in acres.	Outlet.
Dug Pond,	46	
Pond, north of the above,	58	Cochituate Br'k.
Pond on Steep Br'k,	12	
Nonesuch Pond,	48	Charles River.
Waltham.		
Means Pond,	52	Beaver Brook.
Newton.		
Pond, north of Newtonville,	12	None.
Wiswall's Pond,	27	
Hammond's Pond,	28	Charles River.
Arlington.		
Mystic Pond,	232	
Pond, southwest of the above,	13	Mystic River.
Spy Pond,	150	
Belmont.		
Pond, south of Spy Pond,	34	
Ice Pond,	35	Mystic River.
Fresh Pond,	175	
Brighton.		
Chestnut Hill Res'v'r,	125	Boston Water Works.

ESSEX COUNTY (Total No. of acres, 4,570).

Name.	Area in acres.	Outlet.
Methuen.		
Harris Pond,	39	Spickett River.
Mystic Pond,	29	
Lawrence.		
Pond in northwest part,	12	Spickett River.
Haverhill.		
Creek Pond,	156	
Round Pond,	41	
Plug Pond,	21	
Great Pond,	238	Merrimac River.
Pond on line of Amesbury,	33	
Bradford.		
Little Pond,	107	Merrimac River.
Amesbury.		
Pond at River Vil'ge,	14	Merrimac River.
Kimball's Pond,	408	Powow River.
Pond on the State line,	50	
Bailey's Pond,	150	Merrimac River.
Andover.		
Haggett's Pond,	152	Fish Brook.
Pomp's Pond,	17	Shawsheen Riv.
Foster's Pond,	40	
North Andover.		
Great Pond,	645	Cochituate B'k.
Boxford.		
Hovey's Pond,	36	Merrimac River.
Johnson's Pond,	194	
Stiles' Pond,	60	Fish Brook.
Wood Pond,	22	Pye Brook.
Perley's Pond,	54	Penn Brook.
Four-Mile Pond,	42	Pye Brook.
Cedar Pond,	13	Fish Brook.
Spofford's Pond,	13	Pye Brook.
Groveland.		
Crane Pond,	15	Parker River.
Georgetown.		
Rock Pond,	43	Parker River.
Puntucket Pond,	43	
West Newbury.		
Crane-Neck Pond,	10	Parker River.
Ipswich.		
Pritchard's Pond,	93	Pye Brook.
Middleton.		
Middleton Pond,	98	Ipswich River.
Lynnfield.		
Pillings Pond,	83	Saugus River.
Suntaug Lake,	210	Noyes Brook.
Peabody.		
Cedar Pond,	18	Goldthwait's Brook.
Brown's Pond,	54	Tapley's Brook.
Saugus.		
Pond in north part,	25	Saugus River.
Pond in centre,	75	
Lynn.		
Cedar Lake,	35	
Wyoma Lake,	84	Stony Brook.
Wenuchus Lake,	117	
Glenmere Lake.	15	Stacey's Brook.
Mill Pond, in west part,	25	Beaver Brook.
Salem.		
Linmere Pond,	102	Tapley's Brook.
Beverly.		
Beaver Pond,	20	None.
Hamilton.		
Beck's Pond,	26	
Gravel Pond,	30	Essex River.
Round Pond,	30	
Wenham.		
Muddy Pond,	18	None.
Pleasant Pond,	38	Ipswich River.
Cedar Pond,	16	Mile River.
Wenham Lake,	255	
Coy's Pond,	36	Essex River.
Essex.		
Chebacco Pond,	260	Essex River.
Manchester.		
Beaver Dam Pond,	16	Baker's Brook.
Gloucester.		
Coffin's Pond,	12	Jones' River.
Ocean Pond,	35	None.
Rockport.		
Pond in west part,	49	– –

NORFOLK COUNTY (Total No. of acres, 4,350).

Name.	Area in acres.	Outlet.
Needham.		
Morse's Pond, . .	38	Charles River.
Lake Wauban, .	120	
Pond, near centre, .	20	Rosemary Br'k.
Reservoir, northeast part, . . .	27	Charles River.
West Roxbury.		
Jamaica Pond, .	56	None.
Brookline.		
Reservoir, . .	23	Boston Water [Works.
Dover.		
Reservoir Pond, .	25	Chelsea River.
Dedham.		
Buckminster Pond, .	31	Bubbling Br'k.
Pond in northwest part, . . .	10	Charles River.
Wigwam Pond, .	32	
Sprague Pond, .	11	None.
Mill Pond in south part, . . .	20	Bubbling Br'k.
Hyde Park.		
Mill Pond at Readville, . . .	12	Mother Brook.
Milton.		
Houghton Pond, .	28	Blue Hill River.
Medway.		
Pond, northeast part,	26	Charles River.
Norfolk.		
Populatic Pond, .	74	Charles River.
Kingsbury Pond, .	20	None.
City Mills Pond, .	12	Mill River.
Bush Factory Pond,	14	
Pond, south of the centre, . . .	14	Stony Brook.
Walpole.		
Pond, northwest of centre, . . .	23	Neponset Riv.
Pond at E. Walpole,	21	
Bellingham.		
Beaver Pond, . .	108	Charles River.
Pond, northwest of N. Bellingham, .	12	
Pond, northeast of N. Bellingham, .	10	
Pond, south of N. Bellingham, . .	93	
Pond, north of Bellingham Centre, .	18	
Pond, west of Bellingham Centre, .	27	
Jenks Reservoir, .	42	Peters River.
Franklin.		
Beaver Pond, . .	18	Mine Brook.
Pond, north of the above, . . .	31	
Dr. Miller's Reservoirs, . . .	25	Mill River.
Pond in southeast part, . . .	12	

Name.	Area in acres.	Outlet.
Wrentham.		
Stony Brook Resv'r,	75	Stony Brook.
Archer's Pond, .	94	None.
Whiting's Pond, .	244	Mill River.
Shepard's Pond, .	252	Wading River.
Pond, southwest of the above, . .	20	
Pond, northwest of Shepard's Pond, .	17	
Foxborough.		
Pond, near South Walpole, . .	14	Neponset River.
Neponset Reservoir,	365	
Pond, northwest of centre, . . .	62	Cocasset River.
Reservoir, south of the above, . .	28	
Cocasset Pond, .	40	
Reservoir, northwest of the above, .	25	
Pond, south of Cocasset Pond, . .	22	
Two ponds west of Neponset Res'v'r,	12, 10	Neponset River.
Pond, northeast of Shepard's Pond, .	14	Cocasset River.
Pond, south of Shepard's Pond, . .	20	None.
Pond, southeast of Foxboro' Centre, .	12	Rumford River.
Pond, near East Foxborough, . .	13	
Sharon.		
Wolomolopoag P'd,	36	Rumford River.
Massapoag Pond, .	460	Massapoag B'k.
Pond, near Bear-Foot Hill, . .	10	Rumford River.
Reservoir Pond, .	17	PequanticutRiv.
Pond on Foxboro' line, . . .	10	Canoe River.
Canton.		
Ponkapog Pond, .	208	Ponkapog Br'k.
Reservoir Pond, .	209	Massapoag B'k.
Forge Pond, . .	26	
Bolivar Pond, . .	20	
Muddy Pond, . .	10	None.
Stoughton.		
York Pond, . .	10	Beaver Brook.
Pond, west of centre,	19	Massapoag B'k.
Pond, northwest of the above, . .	10	
Muddy Pond, . .	10	
Ames Pond, . .	127	Queset Brook.
Braintree.		
Great Pond, . .	150	Farm River.
Cranberry Pond, .	25	Cranberry B'k.
Weymouth.		
Whitman's Pond, .	247	Weymouth Ba'k [River.
Whortleberry Pond,	12	Mill River.
Great Pond, . .	288	
Cohasset.		
Scituate Pond, . .	53	– –

BRISTOL COUNTY (Total No. of acres, 7,961).

NAME.	Area in acres.	Outlet.
Attleborough.		
Pond, north of North Attleborough,	48	Ten-Mile River.
Pond, east of North Attleborough,	11	
Bungay Reservoir,	118	Bungay Brook,
Pond at Falls Vil'ge,	140	Ten-Mile River.
Pond, east of above,	21	
Pond, south of Robinsonville,	11	
Pond, east of Attleborough depot,	19	Wading River.
Dodgeville Pond,	55	Ten-Mile River.
Pond at Attleboro' City,	31	City Brook.
Pond at Hebronville,	70	Ten-Mile River.
Pond in southeast part,	32	Wading River.
Mansfield.		
Pond at Robinsonville,	10	Wading River.
Pond, south of Robinsonville,	35	
Pond, southwest of West Mansfield,	20	
Pond at Mansfield Junction,	10	Rumford River.
Fulton's Pond,	17	
Kingman & Hodges Pond,	15	
Pond, south of the last,	20	
Grist and Saw-Mill Pond,	19	
Pond, west of Whiteville,	30	Canoe River.
Pond at E. Mansfield.	30	
Norton.		
Buttomennumonthe Pond,	615	Rumford River.
Pond, north of the centre,	12	
Pond, southeast of the centre,	17	
Pond at Barrowsville,	23	
Pond, southwest of Barrowsville,	23	
Pond, east of Barrowsville,	20	
Brass Furnace P'nd,	25	
Winnicunnet Pond,	122	Canoe Brook.
Easton.		
Wilbur Pond,	197	Pequanticut Riv.
Flyaway Pond,	70	Queset Brook.
Lower Pond, at N. Easton,	26	
Upper Pond, at S. Easton,	33	
Lower Pond, at S. Easton,	14	
Pond, south of the centre,	35	Black Brook.
Pond, north of Furnace Village,	12	Mulberry Mead. River.
Pond, west of the above,	45	
Pond, south of Furnace Village,	10	
Pond, southeast of the above,	12	
Raynham.		
Smooch Hill Pond,	12	Two-Mile River.
Gushee Pond,	60	
King's Pond,	20	
Pond, above Raynham Centre,	26	
Pond, below Raynham Centre,	26	
Pond, south of the above,	11	
Seekonk.		
Pond on Pawtucket line,	18	Ten-Mile River.
Pond in northeast corner,	25	
Rehoboth.		
Reservoir,	86	Palmer River.
Pond in southwest part,	24	
Pond on Swansey line,	11	Rocky River.
Swansey.		
Factory Pond,	20	Cole's River.
Pond, southwest of the above,	14	
Taunton.		
Watson's Pond,	78	Mill Creek.
Scadden's Pond,	225	
Prospect Hill Pond,	63	None.
Britanniaville Pond,	15	Mill Creek.
Hopewell Pond,	10	
Pond at Oakland,	20	Three-Mile Riv.
Mill Pond, below Westville,	55	
Pond, southwest of Squawbetty,	23	Cotley River.
Pond, south of the above,	13	
Furnace Pond,	125	Taunton River.
Robinson and Kings Pond,	30	
Dean Factory Pond,	40	
Pond, near Myrick's,	11	Cotley River.
Fall River.		
North Watuppa P'd,	1,490	Mt. Hope Bay.
Cook's Pond,	90	
Freetown.		
Forge Pond,	60	Quaker Brook.
Pond in E. Freetown,	10	Fall Brook.
Westport.		
South Watuppa P'd,	2,007	Mt. Hope Bay.
Sandy Pond,	352	
Devoll's Pond,	62	
Dartmouth.		
Pond, near Freetown line,	23	Shingle Island River.
Hicksville Pond,	23	
Turner's Mills Pond,	48	Fresh River.
Westport Mills P'd,	127	Shingle Island River.
Pond, northwest of above,	67	
Pond at North Dartmouth,	60	Fresh River.
Pond, near Deerfield Swamp,	27	

Bristol County—Concluded.

Name.	Area in acres.	Outlet.
New Bedford.		
Sassaquin's Pond,	51	Fresh River.
Acushnet.		
City of New Bedford Reservoir,	280	Acushnet River.
Pond, near centre of town,	34	Acushnet River.
Pond at Acushnet Village,	16	
Pond on line of Mattapoisett,	30	Mattapoisett River.

Plymouth County (Total No. of acres, 17,623).

Name.	Area in acres.	Outlet.
North Bridgewater.		
Pond west of vil'ge,	25	Salisbury Plain River.
Pond east of vil'ge,	10	
Abington.		
Pond northwest corner of town,	11	Beaver Brook.
Pond south of East Abington,	32	Indian Head River.
Pond at Abington Centre,	49	Poor Meadow.
Pond northeast of South Abington,	25	
Pond east of the above,	22	
Hingham.		
Cushing's Pond,	30	Weir River.
Pond southeast of the above,	18	
Accord Pond,	90	
Pond east part of Hingham,	12	
Hanover.		
Pond in northwest part,	13	Indian Head River.
Pond in southwest part,	24	
South Scituate.		
Pond, near Assinippi Village,	50	Third Herring Brook.
Black Pond,	17	Second Herring Brook.
Dead Swamp Pond,	33	
Pond, South Scituate Village,	12	
East Bridgewater.		
Pond northwest p't,	19	Matfield River.
Pond south of the above,	23	
Pond, west of the Centre,	20	
Lower Pond, northeast of village,	20	
Middle Pond, northeast of village,	14	
Upper Pond, northeast of village,	16	
Pond northeast of Joppa,	15	Satucket River.
Robbins Pond,	140	
Pond, north of the above,	11	
Hanson.		
Pond at N. Hanson,	40	Poor Meadow River.
Pond southwest of the above,	46	
Pond on line of Hanover,	27	Indian H'd Riv.
Maquan Pond,	57	Indian H'd Br'k.
Pond west of the above,	90	
Indian Head Pond,	156	
Pembroke.		
Upper Pond, on line of Hanover,	25	North River.
Lower Pond, on line of Hanover,	16	
Pond northeast of centre,	11	Herring Brook.
Oldham Pond,	237	
Furnace Pond,	120	
Great Sandy Pond,	100	
Hobamock Pond,	15	None.
Little Sandy Pond,	65	Herring Brook.
Stetson Pond,	93	Satucket River.
Jones River Pond,	728	Jones River.
Lower Pond, on line of Duxbury,	39	
Upper Pond, on line of Duxbury,	13	
Marshfield.		
Pond south of South Marshfield,	16	South River.
Duxbury.		
Pond northwest p't,	10	South River.
Round Pond,	11	
Island Creek Pond,	72	Island Creek.
Bridgewater.		
Nunkatesett Pond,	16	Town River.
Nippenicket Pond,	388	
Pond southeast of the centre,	42	
Pond northeast part,	33	Taunton River.
Pond southwest p't,	14	
Halifax.		
Monponsett Pond,	743	Satucket River.
Pond on line of Pembroke,	20	None.
Pond in southwest part,	14	Winetuxet Riv.
Pond in south cor.,	29	
Pond north of the above,	45	
Pond south of Monponsett Pond,	31	
Plympton.		
Pond in south cor.,	25	Whetstone Br'k.
Kingston.		
Pond near corner of Duxbury and Pembroke,	10	Jones River.
Blackwater Pond,	29	
Crosman's Pond,	15	

PLYMOUTH COUNTY—Concluded.

NAME.	Area in acres.	Outlet.
Pond southeast of the above,	15	Jones River.
Great Indian Pond,	91	None.
Muddy Pond,	61	
Smelt Pond,	92	Smelt Brook.
Lakeville.		
Pond, north of T. & M. Railroad,	11	Taunton River.
Dunham's Pond,	10	None.
Clear Pond,	21	
Elder's Pond,	167	Namasket Riv.
Long Pond, north of above,	20	None.
Long Pond, on line of Freetown,	1,760	Namasket Riv.
Little Quittacas P'd,	360	
Great Quittacas P'd,	1,255	Mattapois't Riv.
Pocksha Pond,	497	Namasket Riv.
Assowonipsett P'nd,	2,220	
Middleborough.		
Pond in Waterville,	27	Whetstone B'k.
Wood's Pond,	45	Fall Brook.
Tispaquin Pond,	175	
Benson's Pond,	11	Sampson's Br'k.
Pond north of the above,	14	
Carver.		
Muddy Pond,	50	Winetuxet Br'k.
Cooper's Pond,	40	None.
John's Pond,	16	Winetuxet Br'k.
Wenham Pond,	37	S. Meadow B'k.
Vaughan Pond,	13	None.
Dunham Pond,	40	Sampson's Br'k.
Pond southeast of the above,	55	
Federal Pond,	100	
Sampson's Pond,	234	
Cedar Pond,	30	None.
Clear Pond,	12	
Barrett's Pond,	12	
Plymouth.		
North Triangle P'd,	10	None.
Darby Pond,	51	S. Meadow B'k.
Muddy Pond,	14	
Clear Pond,	12	None.
Billington Sea,	306	– –
Lout Pond,	18	None.
West Pond,	75	
Micajah's Pond,	10	
King's Pond,	15	
Pond west of the above,	19	
Cook's Pond,	21	
South Triangle P'd,	20	
Little South Pond,	54	Eel River.
Grassy Pond,	14	None.
Great South Pond,	318	Eel River.
Boot Pond,	74	
Jenkins Hole,	19	None.
Gunner's Exchange Pond,	98	
Russell Mills Pond,	52	Eel River.
Old Colony Duck Company Pond,	14	
Beaver Dam Pond,	115	Beav'r Dam B'k.
Fresh Pond,	57	None.
Little Island Pond,	15	
Shallow Pond,	15	
Island Pond,	82	
Clam Pudding Pond,	10	
Wiggin's Pond,	25	

NAME.	Area in acres.	Outlet.
Pond, northwest of the above,	15	None.
Clew Pond,	50	
Dunham Pond,	12	
Rocky Pond,	32	Sampson's Br'k.
Furnace Pond,	48	
College Pond,	50	None.
Three-Cornered P'd,	20	
Long Pond, near the above,	44	
Bump's Pond,	16	
Little Long Pond,	54	
Gallows Pond,	43	
Half-Way Pond,	223	Agawam River.
Long Pond, near the above,	240	None.
Bloody Pond,	93	
Savery's Pond,	56	– –
Fearing Pond,	65	None.
Fawn Pond,	20	
Charge Pond,	45	
Lond Pond, on line of Wareham,	20	
Five-Mile Pond,	23	
White Island Pond,	396	Reed Brook.
Sandy Pond,	121	None.
Ezekiel's Pond,	38	
Little Sandy Pond,	11	
Little Herring Pond,	70	Monument Riv.
Herring Pond,	435	
Rochester.		
Snippatuit Pond,	885	Mattapois'tt Riv.
Long Pond,	33	None.
Snow's Pond,	82	
Pond southwest of the above,	76	Mattapois'tt Riv.
Cary's Pond,	92	Sippican River.
Pond west of the above,	59	
Pond south of Cary's Pond,	96	
Marion.		
Pond near Lawrence Swamp,	12	Mill Creek.
Wareham.		
West Wareham P'd,	45	Weweantic Riv.
Pond south of West Wareham,	23	
Pond southeast of the above,	28	
Blackmore Pond,	55	Sippican River.
Pond north of Blackmore Pond,	92	Weweantic Riv.
Pond northwest of the above,	23	
Pond at Tihonet,	97	Frog-Foot Riv.
Pond west of the above,	20	
Pond near Wareham Narrows,	62	Wancinco Riv.
Flax Pond,	31	None.
Pond northwest of Flax Pond,	112	Agawam River.
Beaver Dam Pond,	20	– –
Swift's Pond,	50	– –
Sturtevant's Pond,	13	None.
Cedar Pond,	13	
Spectacle Pond,	85	
Pickerel Pond,	23	
Glen Mill Pond,	65	Agawam River.
Bartlett's Marsh P'd,	55	

BARNSTABLE COUNTY (Total No. of acres, 9,721).

NAME.	Area in acres.	Outlet.
Sandwich.		
Ellis Pond,	25	– –
Pond southwest of Sandwich Village,	47	Mill River.
Queen Sowett Pond,	14	None.
Bourne Pond,	13	
Mill Pond,	57	Back River.
Deep Bottom Pond,	34	None.
Flax Pond,	64	
Upper P'd, Pocassett,	20	Barlow River.
Lower P'd, Pocassett,	10	
Pond southwest of Flax Pond,	21	
Pond in S. Pocasset,	22	
Long Pond,	28	
Succonnessett P'ds,	12 12	
Weeks' Pond,	12	None.
Snake Pond,	76	
Peters Pond,	176	
Spectacle Pond,	151	
Triangle Pond,	84	
Lawrence Pond,	70	
Two ponds at East Sandwich,	12 12	 – –
Falmouth.		
Pond at North Falmouth,	25	– –
Pond southwest of North Falmouth,	26	– –
Deep Pond,	34	None.
Coonemossett Pond,	100	– –
Crooked Pond,	73	
Shallow Pond,	12	
Jenkins Pond,	42	
Spectacle Pond,	20	None.
Mare's Pond,	38	
Long Pond,	205	
Fresh Pond,	42	– –
Ponds northeast of Falmouth Village,	10 11 16	None. – – None.
Factory Pond, north of East Falmouth,	19	– –
Pond east of the above,	15	– –
Mashpee.		
Pimlico Pond,	14	None.
Wakeby Pond,	375	Marshpee River.
Marshpee Pond,	395	
Santuit Pond,	170	Cotuit River.
Ashumet Pond,	226	None.
John's Pond,	240	
Barnstable.		
Pond, south of West Barnstable,	18	Scorton Creek.
Spruce Pond,	12	Bridge Creek.
Steward's Pond,	36	None,
Long Pond, in west part,	63	
Pond at Newtown,	25	– –
Shubael Pond,	50	
Pond south of the above,	13	None.
Pond southwest of Shubael Pond,	126	
Pond north of the above,	118	– –
Pond west of the Plains,	147	None.
Pond northwest of the above,	11	

NAME.	Area in acres.	Outlet.
Lovell's Pond,	48	None.
Two ponds north of Osterville,	14 15	
Mill Pond west of Centreville,	16	– –
Pond north of the above,	12	– –
Great Pond,	700	
Shallow Pond,	90	
Hathaway's Pond,	15	
Pond north of the above,	21	
Israel's Pond,	21	
Small Pond,	22	None.
Half-Way Pond,	12	
Lewis Pond,	10	
Two ponds west of Hyannis,	12 10	
Long Pond, near Centreville,	69	
Yarmouth.		
Dennis Pond,	50	
Long Pond, near the above,	11	None.
Taylor's Pond,	39	
Flax Pond,	20	
Mill Pond,	81	Hamblin Brook.
Flax P'nd, near west Yarmouth,	15	None.
Pond west of the above,	50	Thornton Br'k.
Horn Pond,	14	None.
Plashes Pond,	65	Parker's River.
Swan Pond,	70	
Long Pond, near S. Yarmouth,	94	None.
Pond, south of Long Pond,	20	
Three ponds near South Dennis,	12 10 13	– – None.
Dennis.		
Scargo Lake,	60	Sesuet Creek.
Flax Pond,	20	
Run Pond,	20	
Simmons Ponds,	22 11	
Grassy Pond,	22	None.
Pond on line of Harwich,	23	
Pond southwest of the above,	20	
Swan Pond,	179	Swan Pond Riv.
Pond northwest of the above,	10	None.
Pond southeast of South Dennis,	29	
Pond southwest of West Dennis,	25	– –
Brewster.		
Mill Pond,	365	Herring River.
Pond east of Mill Pond,	54	
Pond south of Mill Pond,	51	None.
Two ponds west of Mill Pond,	25 34	
Pond northwest of Mill Pond,	23	Quivett Creek.
Pond north of Mill Pond,	22	None.

BARNSTABLE COUNTY (Concluded).

NAME.	Area in acres.	Outlet.
Pond N. of Brewster Village,	21	– –
Griffith's Pond,	32	None.
Bang's Pond,	130	Herring River.
Long Pond,	778	
Sheep Pond,	132	
Pond northwest of Long Pond,	20	
Two ponds east of Long Pond,	12 60	
Two ponds south of East Brewster,	17 22	
Cliff Pond,	141	None.
Two ponds north of Cliff Pond,	40 13	
Two ponds east of Cliff Pond,	16 44	
Three ponds south of Cliff Pond,	15 11 15	
Harwich.		
Hinckley's Pond,	153	Herring River.
Island Pond,	21	
Grass Pond,	74	– –
Pond northeast of the above,	15	None.
Skinequit Pond,	20	Red River.
Hawk's Nest Pond,	60	
Pond W. of Hawk's Nest Pond,	27	
Two ponds south of Hawk's Nest P'd,	23 16	None.
Pond northeast of Hawk's Nest P'd,	26	
Chatham.		
Goose Pond,	66	
Four ponds west of Goose Pond,	15 11 29 13	None.
Pond, southwest p'rt,	14	– –
Pond, southwest of West Chatham,	15	– –
Two ponds east of Goose Pond,	14 25	None.
Two ponds southwest of Great Hill,	10 31	
Pond, northwest of Great Hill,	24	– –
Pond, north of the above,	13	– –
Orleans.		
Baker's Pond,	88	
Pond, south of Orleans Village,	43	
Pond, southeast of the above,	53	None.
Pond, east of the village,	11	
Pond in south part,	18	
Eastham.		
Pond, northwest cor.	10	
Pond, north of centre,	17	
Great Pond,	112	None.
Pond, east of Great Pond,	39	
Herring Pond,	45	
Wellfleet.		
Herring Pond,	19	Herring River.
Higgins Pond,	25	
Gull Pond,	95	
Long Pond,	34	None.
Great Pond,	42	
Hopkins Pond,	10	
Truro.		
Mill Pond,	17	Pamet River.
Higgins Pond,	17	
Pond, north of Higgins Pond,	14	None.
Newcomb's Pond,	32	
Long Pond,	28	
Provincetown.		
Great Pond,	45	
Black-Water Pond.	11	
Pasture Pond,	14	
Clapp's Round P'nd,	10	None.
Duck Pond,	20	
Clapp's Pond,	72	
Shank Painter P'nd,	83	

DUKES COUNTY (Total No. of acres, 90).

NAME.	Area in acres.	Outlet.
Gosnold.		
Pond, west part of Naushon,	65	None.
Pond, east past of Nashawena.	25	None.

NANTUCKET COUNTY (Total No. of acres, 33).

Nantucket.

Gibbs' Pond, ... 33 acres—No outlet.

RECAPITULATION.

Berkshire County,	6,226
Franklin County,	2,184
Hampshire County,	2,282
Hampden County,	4,148
Middlesex County,	8,743
Worcester County,	25,007
Essex County,	4,570
Norfolk County,	4,350
Bristol County,	7,961
Plymouth County,	17,623
Barnstable County,	9,721
Dukes County,	90
Nantucket County,	33
Total area of ponds (area over 10 in acres) in Massachusetts,	92,938

Additional Analysis of Evidence as to the Use and Abuse of Intoxicating Liquors.

BEER-SHOPS AND PROHIBITORY LAWS.

By P. EMORY ALDRICH,

MEMBER OF THE STATE BOARD OF HEALTH.

BEER-SHOPS AND PROHIBITORY LAWS.

The fourth section of the "Act to establish a State Board of Health" declares that "It shall be the duty of the board, and they are hereby instructed to examine into and report what, in their judgment, is the effect of the use of intoxicating liquor, as a beverage, upon the industry, prosperity, happiness, health and lives of the citizens of the State. Also, what additional legislation, if any, is necessary in the premises." This Act was passed in the year 1869. The Board, through its chairman, early entered upon an extensive correspondence with persons in this and foreign countries, who from their official or professional positions, were supposed to be peculiarly qualified to communicate important and authentic information to guide the Board in the discharge of that part of its duty set forth in the section of the law above cited. This correspondence was published with the report of the board for the year 1871. The Third Annual Report of the Board contains an "Analysis," by the Chairman, "Of the Correspondence on the Use and Abuse of Intoxicating Drinks throughout the globe, which was presented to the legislature in 1871, or Intemperance as seen in the light of Cosmic Law."

That analysis, or as it may properly be called essay, attracted very general attention among those who were ready to adopt the views expressed by the author, as well as among those who dissented from some of his conclusions. The portions of that essay which have encountered the most adverse criticism, are those in which the writer expresses the "belief that the permission to sell mild ales, beer and light wines would, under certain very general rules, be really a promotion of temperance in New England, as it apparently is elsewhere." That "light German beer and ale can be used even freely without any very apparent injury to the individual, or without causing intoxication." That "light grape-wines,

unfortified by an extra amount of alcohol, can be drunk less freely without injury to the race, and with exhilaration rather than drunkenness. Some writers think they do no harm, but a real good if used moderately. They never produce the violent, crazy drunkenness, so noticeable from the use of the ardent spirits of the North." That "the example set by California and Ohio should be followed by the whole country, where the vine can be grown. As a temperance measure, it behooves any good citizen to promote that most desirable object. We should also allow the light, unfortified wines of Europe to be introduced free of duty, instead of the large one now imposed. Instead of refusing the German lager beer, we should seek to introduce it into the present "grog-shops," and thus substitute a comparatively innoxious article for those potent liquors, which now bring disaster and death into so many families."

From the last sentence quoted, as well as from the general tenor of his discussion, the author of the "analysis" can have no sympathy with the manner in which the beer-shops are now conducted in this Commonwealth, or be found among the advocates of their continuance; for as the governor in his late annual message declares, "A beer-shop, so called, has come to mean generally, a place where all kinds of intoxicating liquors are furnished; and nine-tenths of them, as the chief constable of the Commonwealth affirms, use their licenses as a cover for the sale of distilled spirits."

The Board, acting as they believed, in accordance with the spirit of the law defining their duties, presented the "analysis" prepared by their Chairman "as a valuable contribution to the discussion of the general subject of the use and effect of intoxicating drinks, *but without expressing, as a Board, any opinion concerning the inferences made by the writer, or on the special methods advocated by him.*"

And now, without attempting to commit the Board to any peculiar views of my own, I propose to submit a further analysis of evidence contained in written and printed documents received from the correspondents of the Board and from other authentic sources, bearing upon the two questions as to the effect of restrictive legislation upon the sale of intoxicating liquors and the establishment of beer-shops.

And first, What in the light of experience and observation has been the effect of beer-shops upon "the industry, prosperity, happiness, health and lives" of the people?

One of the most important documents in the possession of the Board upon this subject, is a printed "Report by the Committee on Intemperance for the Lower House of Convocation of the Province of Canterbury," England. This report was made in the year 1869. The committee that made the report was appointed "To consider and report on the prevalence of Intemperance, the evils which resulted therefrom, and the remedies which may be applied." The Province of Canterbury embraces thirty-two English counties, and North and South Wales, and contained a population at the date of the report of 14,071,164. The territory and population covered, by the statistics upon which the report is based, will be seen therefore to have been large. Full and minute inquires as to: 1, The extent of the evil of intemperance; 2, probable causes; 3, results; and 4, remedies, were addressed by the committee to the (1) clergy of the province; (2) to the recorders of England and Wales; (3) governors and chaplains of prisons throughout Great Britain; (4) chief constables and superintendents of police throughout Great Britain; (5) superintendents of lunatic hospitals throughout England and Wales; (6) coroners throughout England and Wales; (7) governors of workhouses throughout England and Wales.

Replies were received from the persons addressed, to the number in all of twenty-two hundred and eighty-three, and one of the "results" of intemperance as shown by the unvarying testimony of persons having the fullest means of correct information, was that from three-fourths to nine-tenths of the crime and poverty existing in the province could be traced to the intemperate use of intoxicating liquors. But it is aside from the present purpose to dwell upon this aspect of the great and intolerable evil of intemperance; and I proceed at once to examine the evidence found in this remarkable report, bearing upon the question as to whether *beer-shops are or not a cause of intemperance.*

The committee, in presenting their report of the evidence they have with so much industry accumulated, affirm that of

"the direct causes of our national intemperance, one of the foremost and the most prolific, as it appears to your committee is, the operation of the legislative Act which called beer houses into existence, and placed the power of licensing them in the hands of the excise. This measure, though introduced in 1830 *for the avowed purpose of repressing intemperance by counteracting the temptations to the excessive drinking of ardent spirits afforded in public houses, has been abundantly proved, not only to have failed of its benevolent purpose, but to have served throughout the country to multiply and intensify the very evils it was intended to remove.*" And the committee add: "It is a fact worthy of record, that the late Lord Brougham, who anticipated the spread of sober habits from the beer-shop system, was eventually so impressed with its multiplied evils, that he introduced into the House of Lords a bill for the repeal of the Beer Act, and succeeded in inducing the peers to assent to a resolution affirming the principle of his measure."

These statements of the committee are fully sustained by the testimony they publish :—

1. Of Clergymen.

"The Duke of Wellington's Beer-House Act was the origin of much of the existing evil."

"Intemperance much increased since beer-shops were introduced some years ago, especially among young men."

"The beer-houses are an unmitigated nuisance."

"Intemperance has increased here with the number of beer-shops."

"The Act permitting beer-shops is here, and I think everywhere, a curse."

"The beer-houses are a great evil."

"The increase of intemperance is entirly owing to the setting up of first one, and afterward a rival beer-shop. I do not see how any thoughtful person, who cares for the well-being of the poor, can feel otherwise than that the State, by its encouragement of the multiplication of the beer-shops, commits a great national sin, which must one day be punished by a national retribution."

"If I am asked to point out the great cause and encouragement of intemperance, I have no hesitation in ascribing it, in a great measure, to that most disastrous Act of parliament which set beer-shops on foot."

"*No public-house or beer-shop.—No intemperance.*—With reference to intemperance in other parishes, I have no doubt that it is largely increased by the low beer-houses."

"Intemperance very much *decreased* by the influence of the landlord shutting up a beer-shop which formerly did much mischief."

"To my sorrow there are two beer-shops in this parish, neither of which has been established any great number of years. I have no doubt as

to their influence. Many families in which the wives and children were formerly well clad and apparently well fed, have, since the introduction of the beer-shops, been in rags and poverty-stricken. I have been here thirty years, during the greater part of which there was no beer-shop in the parish; I have, therefore, every opportunity of observing the effects either for good or evil, and I can come to no other conclusion than that the beer-shops, as at present conducted, are the very sinks of iniquity and vice."

Testimony of Coroners.

"In my opinion, beer-shops are a crying evil in rural districts."

"Beer-houses a great source of crime and poverty."

"The only remedy I can suggest is, a repeal of the law which enables a beer-house to be opened everywhere, and in that way remove many of the temptations which in these days beset a poor man at every turn. In my opinion, the number of public-houses of one class and another are a curse to the country."

"I have no doubt that beer-shops and gin-shops are the principal causes of intemperance."

Testimony of Chief Constables and Superintendents of Police.

"I am of opinion that much good would be effected by the closing of all beer-shops."

"I say that the beer-houses should be closed altogether. They are great inducements to drunkenness."

"I think doing away with beer-houses would cause less drinking, and prevent most of the misery arising therefrom."

"The beer-houses are a frightful source of intemperance."

Testimony of Governors of Workhouses.

"Beer-houses are the seat of vice and intemperance."

"The abolition of beer-houses would be a boon to the country."

"It appears to me one great check to intemperance would be that of closing beer-houses."

"I consider the present beer-house system very bad."

"It appears to me one great check to intemperance would be that of closing beer-houses."

"The abolition of beer-houses would be a boon to the working-man."

And so the testimony runs on through many pages of the report, but which it cannot be necessary to transcribe here.

This experiment for promoting the cause of temperance in England by the establishment of beer-shops there, may furnish perhaps the best practical criterion by which to judge of the results of a similar enterprise here. But we are not upon this subject left to form our opinions entirely upon foreign testimony and experiment. To the question, Does the sale of ale and beer increase or diminish crime? I have the written answers of several classes of public officers whose

connection with the courts of this State gives them unusual opportunities of forming a correct judgment upon the subject of the above inquiry.

1. *Answers of District-Attorneys.*

"It tends to an increase, due largely to the fact that the beer business supports many low places of resort and covers the sale of spirituous liquors."

"To this question it is impossible to give any answer based on facts. It is impossible to separate the results of these liquors, from the results of stronger liquors in any way to give satisfactory conclusions."

"Decidedly to increase crime."

"I have not been long enough in office to answer this intelligently. I think it an open question."

"I answer that the 'exemption of malt liquors and cider' clearly does not tend to diminish crime. How much increase of crime may be due to it I am unable to say."

"In my district nearly all the towns refuse to permit the sale of ale, &c."

2. *Answers of City Marshals and Chiefs of Police.*

"It increases crime."

"Increase."

"It does not decrease it, as under the free-beer law, the doors for the sale of ale and beer are thrown wide open, their sale and consumption increased and the *sale of distilled liquors is in no way diminished.* That 'free beer' decreases drunkenness, may be logic but isn't fact."

"About the same—if anything on the increase."

"Increase."

3. *Answers of City Missionaries.*

In reply to the question "what is the effect of the beer clause?"

"Bad and only bad."

"The effect has been to increase rather than diminish the amount of drunkenness in my district."

"Free beer means free rum."

4. *Answers of Judicial Officers to the same question.*

"It has already produced an alarming increase (of drunkenness) in many places."

"The unrestricted sale of beer is a fruitful source of intemperance and crime."

"As the city of Haverhill and surrounding towns have voted not to allow the sale of beer, I am not aware of any perceptible effect in this vicinity."

"Decidedly bad, so far as my knowledge extends."

It may be remarked in passing, that the papers from which the foregoing extracts are taken, show that the judicial and

prosecuting officers of the Commonwealth, city marshals and chiefs of police, keepers of prisons and superintendents of almshouses, all concur in attributing a large proportion of the crime and poverty existing in the community, to the use of intoxicating liquors.

Does the use of wines and malt liquors, and cider, tend to create an appetite for stronger liquors?

Answers to this question have been received from a large number of physicians. Their answers are not uniformly the same, though a large majority answer the question in the affirmative. One who has had very great experience in the treatment and care of the intemperate, says:—

"As far as my observation goes, the use of ale, wine and other fermented liquors does stimulate the desire for stronger drinks. The very nature of the case proves this. The disease, drunkenness, alcoholism or whatever you please to call it, *is generally superinduced by fermented drinks. Primarily they lay the foundation for the disease, and stronger liquors are usually resorted to for the reason that the weaker drinks fail to meet the demand of the diseased organism,* and when once this disease is acquired, the miserable victim goes on from day to day, demanding more and more of the poison, until death or curative agents release him from his thraldom."

Another physician of great eminence and extensive practice says:—

"Alcohol taken into the system produces the same effect, whether it be pure alcohol, rum, whiskey, gin or brandy or if it be wine, malt liquor or cider. So far as the alcohol is concerned the effect is the same, but the effect upon the system is greatly modified by the amount contained in the drink and by the vehicle in which it is conveyed. In wines there is less of alcohol than in ardent spirits. Different wines contain a different amount of stimulant. Malt liquors and cider do also contain alcohol, but in comparatively small amounts, and it is combined with other ingredients which are nutritious in some degree, and this makes the effects of each of them somewhat specific in their character. The beer drinker carries his marks with him. And the cider drinker is readily recognized in our country. So far then as alcohol is taken it tends to create an appetite for stronger liquors."

Another physician of equal eminence answers the question quite differently. He affirms that,—

"The experience of nations who use wines, malt liquors and cider, does not, in my opinion, prove that these beverages create an appetite for stronger liquors, and on the contrary, I think the experience of our own country

(which has never had mild wines, and has never used as freely as the Germans do, ale or mild beer, so that the Americans as a rule have been compelled to use the stronger liquors), proves that a people without wines or ales is liable to have in the highest degree this craving for stronger liquors. For certainly our race is more drunken then any European or mild-wine-drinking race, wherever it may be found."

This view of the subject is somewhat weakened, when it is remembered, that in France, a wine-producing country, and where light wines have been a common beverage of the people, the use of absinthe and other stronger liquors has become so great that the physicians of that country, "after various academic discussions of the evils resulting therefrom, have felt called upon to solemnly warn the French nation against such use."

That is, the free use of light wines has not prevented the people of France indulging in the use of stronger and more injurious stimulants.

And this leads naturally to the consideration of some important evidence respecting the use of wine, in the vine-growing portions of our own country. I am well aware that the testimony of travellers and residents upon this subject is contradictory. Some letters published in the last report of this Board, expressed the opinion that the culture and use of wines in Ohio, and California "had contributed to the lessening of intemperance," in those great States of the near and remote West.

I have now before me letters presenting a very different view of this matter.

A distinguished clergyman formerly of New England, but who has resided many years in California, writing under date of April 22, 1872, says:—

"This is undoubtedly one of the more favorable countries in the world, in soil and climate, for the cultivation of the vine. We have an immense capital already invested in the business,—certainly not less than $30,000,000. Every year extends our vineyards, and adds to the number of gallons of wine and of brandy manufactured on this coast. Last year's vintage yielded about 6,000,000 gallons of wine, and there were manufactured over 200,000 gallons of grape brandy. The annual average increase in the business is not far from $2,000,000. It is more and more evident that the abundance and cheapness of our wines, as well as their quality, both pleasant and strong, increase fearfully the amount of intemperance in California. In our wine-growing districts, and these are everywhere, there are very few families who

do not use wine freely. Whole communities are saturated with wine, men and women, young and old. *Nor does the drinking stop with wine. Beginning with this comparatively pure product it graduates speedily into the use of brandy and whiskey, and the worst of adulterated liquors.*"

The editor of "The Pacific" writing from his office in San Francisco under date of April 15, 1872, says:—

"Lager-bier has been freely made and used in this State for many years,—is not limited by any means to the German population, and is consumed in large quantities in mining districts, grain districts, fruit districts and wine districts. Nothing displaces it; nor does it displace anything. We have never heard of it as a temperance drink. Lager drunkenness is too frequent for that. Our impression is that the lowest, slowest, most illiterate, most unimpressible, most unimprovable, if not most vicious population, outside of the great cities, is found in the oldest wine districts of this State; and that the use of the product of vineyards has been the most active cause of this condition of the population; that the increased production and consumption of wine, on this coast, in the more recent years has diminished the use of neither distilled liquors nor lager-bier, but rather increased the demand for both. We never hear of people who forsake liquors and beer for the sake of wine; but we hear of many who never used an intoxicant, till they learned to love wine, and then have abandoned wine for something more stimulating. In a word, we do not believe that wines reform anybody, and we do believe that they beguile many into drinking habits, and finally into drunkenness, who would never have drank a drop but for wine."

Enough has been shown it would seem to demonstrate that the beer-shop system has in this country, as it did in England, signally failed, so far as it was expected to promote temperance or diminish intemperance and its attendant evils.

And it will be difficult to maintain the consistency or wisdom of the legislation, which does not include under the same prohibition, the sale of fermented and other intoxicating liquors. Especially would this seem to be true as a practical question in this Commonwealth, where upon the highest authority we are assured that nine-tenths of all the beer-shops have degenerated into mere grog-shops and tippling-houses; which, by the confession of every citizen who cares for the public welfare, are an intolerable pest and nuisance. And it is precisely on this ground,—because the traffic in intoxicating liquors as beverages becomes a common nuisance, producing great public evils,—crime, pauperism, public disorder and insecurity,—and resulting in consequent burdensome taxation, that the right and duty of the legislature arise to interfere by

regulative or prohibitory statutes. It is not upon the ground that the legislature has the right to interfere with the personal habits or private business of the citizen, except and only when these result in the production of the public evils above enumerated.

This brief statement will be closed by a reference to a few facts in the history of Sweden, illustrative of the beneficial effects of prohibitory laws, upon the production and sale of intoxicating liquors. These facts are taken from a manuscript letter, addressed to the Chairman of this Board from O. Carlhiem Gyllenskiöld, Chief of the Statistical Office in the Department of Justice. The letter was forwarded to the State Department at Washington, by Mr. Andrews, United States Minister at Stockholm, and from the State Department was sent to the Chairman of this Board. The letter may therefore be regarded as of the highest authenticity, and its statements entitled to full credit. Sweden is somewhat isolated in position, and her internal or domestic policy less liable to be affected by foreign influences than that of most European countries. The force and effect of her own legislation and domestic policy, can therefore be the more surely determined.

I proceed to quote from the letter :—

"In the time of our heathen ancestors, *ale* and *mead* appear to have been the only liquors of an exhilarating nature, commonly used in their houses. After the introduction of Christianity and the promulgation of the Roman Catholic faith, from the year A.D. 830, *wine* became more generally known and used; with the decline of the Church declined also the morals, and drunkenness became not an uncommon occurrence in all grades of society. In the latter half of the 15th century *distilled spirit* first became known in this country. and the use of it as a beverage, gave the Regent occasion, so early as 1494, to issue a prohibition against it."

The stages by which this result was reached should be noted: first, *ale* and *mead* were the only drinks; second, *wine*, leading to drunkenness; third, *distilled spirit*, producing such a state of things, as to call for the prohibitory Act of the government. If the use of ale and beer will cure or prevent the appetite for stronger drinks, why did it not have that effect among the Swedes?

But to resume our quotations :—

"These prohibitions were afterwards several times (1525–1840) proclaimed by the great social reformer, establisher of the Reform Church in Sweden, *Gustavus Vasa.*

"His son and successor, King John III. again permitted distillation, after which it was not long before the abuse of it as a drink spread. *Gustavus Adolphus* was consequently induced again to prohibit the sale of ardent spirits, but as this prohibition was repealed after his death, the distillation and consumption of spirits in certain districts, took such overwhelming proportions during the reign of Charles XI. (1660–1697), that even he was induced to take energetic measures to confine it within bounds. His son, Charles XII., who himself, from the commencement of his reign in his 17th year, never consumed any other fluids than water and milk, prohibited and maintained with vigor the prohibition against the distillation and sale of ardent spirits. During his wars abroad, the home government suspended the prohibitory ordinance. But upon the return of the king in 1715, one of his first cares was to counteract the pernicious consequences arising from the general liberty allowed for distillation. But hardly had the murdering bullet in the trench at Frederickshald, the 30th of November 1718, put an end to the king's life, before distillation was again rendered free, after which for more than 130 years, with few and short exceptions, spirits flowed, sometimes as it were inundating the country and causing the most terrible ravages. A vigorously maintained prohibition against spirits in 1753–1756, and again in 1772–1775 proved the enormous benefits effected in moral, economical and other effects by abstinence from spirits."

And thus the nation rose and fell, grew prosperous and happy, or miserable and degraded, as its rulers and law-makers restrained or permitted the manufacture and sale of that which, all along the track of its history, has seemed to be the nation's greatest curse. But there is not space here further to trace this very instructive branch of the history of one of the most remarkable nations of Europe, illustrating as it does nearly every phase of the "Liquor Question" which has arisen in this country, or is likely to arise, and the careful study of which could hardly fail to furnish our legislators and statesmen with invaluable information to guide them in dealing with a subject second in importance to no other within the range of American legislation.

REPORT

ON THE

CHARACTER OF SUBSTANCES USED

FOR

FLAVORING ARTICLES OF FOOD AND DRINK.

By HENRY K. OLIVER, M. D.

CHARACTER OF SUBSTANCES USED FOR FLAVORING ARTICLES OF FOOD AND DRINK.

In the spring of the present year, rumors of cases of illness, occurring some months previously in a family in Boston, and caused, as was supposed, by eating ice-cream of a certain flavor, came to the ears of the writer of this Report, and were communicated by him to the Secretary of the State Board of Health. This led to the suggestion, that the character of the substances employed for flavoring articles of food and drink receive investigation. Inquiry into the cases of illness alluded to was first made, and it was found that diarrhœa and vomiting had occurred in four or five individuals soon after partaking of a lunch of *pistache* ice-cream and other articles of a simple character, and that it was the firm impression of those affected that the ice was the offending substance.

Application was made by the writer to the manufacturer of the ice, a well known and widely patronized confectioner in Boston, who stated that the essential oil of bitter almonds had been employed to heighten the flavor of the cream. He added that, very probably, too much of the oil had been accidentally used. The oil had been obtained of a druggist in New York, and it was subsequently learned from him that it was of the manufacture of Allen, an English druggist, who is the distiller of the greater portion of the oil of bitter almonds imported into this country. The article of his manufacture is reputed to be of excellent quality, but this essential oil always contains hydrocyanic (prussic) acid, unless special processes for its removal are employed. This, however, is so rarely done, that it is safe to infer that the commercial oil has not been deprived of its poisonous element. That there might not be any doubt upon this point as regards Allen's

oil, a specimen was subjected to analysis, with the result of finding the presence of prussic acid.*

In this investigation of the character of flavoring substances, many articles in common use, such as the spices, have been eliminated, although deleterious substances are undoubtedly largely used in their adulteration. With this elimination, the list of substances possessed of sapid principles in common use is still pretty large. It includes the fruits, strawberry, raspberry, peach, pear, cherry, quince, currant, grape, lemon, orange and pine-apple. In addition, there are the winter-green, yielding the so-called checkerberry flavor, the sassafras, the peppermint, the bitter almond, the vanilla-bean and the rose.

Except to persons of peculiar idiosyncrasy, the fruits, etc., mentioned above are harmless, and perhaps to only one of them are individuals at all susceptible, namely, the strawberry, which some persons cannot eat without experiencing disagreeable symptoms. Of the other articles named, the winter-green, the sassafras, and the peel of the lemon and the orange, yield essential oils by distillation, which, like all essential oils, will produce irritation of the stomach and symptoms of intoxication when taken in large quantities and undiluted, but which contain no active poisonous element, as does the essential oil of bitter almonds. It ought to be mentioned, however, that the oil of lemon may, by exposure to the air, and perhaps to the light alone, undergo a change into oil of turpentine, but this change is of course readily detected.

It has long been desired to increase the list of the fruit flavors, and a resemblance to the taste of fruits not readily preserved, or not to be procured in sufficient quantity, has been obtained by the union of two or more flavors. The flavors of pine-apple and raspberry mixed, give a resemblance to strawberry; those of orange and almond, the nectarine. But, about twenty or twenty-five years ago, it was discovered that certain compound ethers possessed the odor and the flavor of many flowers and fruits, and a disposition was soon

* The analyses referred to in this Report have been made by Mr. H. B. Hill, Assistant in Chemistry in Harvard University, who has conducted for the Board of Health the investigations into the character of the adulterations of food.

manifested to take advantage of this circumstance. The list of flavors could then be greatly enlarged ; perishable and rare fruits could be cheaply imitated in flavor by substances unchangeable and always at hand, and most persons would fail to detect the imposition. It is said to have been the opinion of some chemists, that the odors and flavors of flowers and fruits are really due to the presence of these ethers, and it is probable that this circumstance has greatly encouraged their employment.

It will be one of the objects of this Report to determine, not only the character of these factitious flavors, but also to what extent, and in what articles, they are employed.

In addition to those mentioned, other substances are employed in flavoring as substitutes for the genuine. Tartaric acid is often used, instead of lemon or its acid (citric), in the manufacture of lemon-sirup, and is also used to give tartness to jellies and to fruit-pastry, when the former are made of other fruits or other substances than they pretend to be, and when the latter contains no fruit at all. These facts will be made apparent in several stages of this Report.

The question of the substitution of nitro-benzole for the oil of bitter almonds will be briefly touched upon, in connection with the consideration of the latter article, which will hold prominent place.

A bare allusion will be made to some flavoring substances of a harmless nature, and the question of the use of strychnine in ales will receive brief notice.

Finally, the change from an innocent to a noxious substance, which sometimes takes place in the alcoholic extract of the vanilla-pod, seems to come appropriately into a report of this character ; as does, perhaps, the large adulteration of this bean by the tonka-bean.

Essential Oil of Bitter Almonds.

The subject of the essential oil of bitter almonds claims first attention. This is obtained from the kernels of the fruit of *Amygdalis communis*, variety *amara*.

Christison, in his work *On Poisons*, says :—

"In small doses, the bitter almond produces disorder of the digestive organs, nausea, vomiting, and sometimes diarrhœa. These symptoms are

occasionally brought on by the small quantities used for flavoring sweetmeats, particularly when the confectioner has not been careful in compounding them. Virey says that accidents occasionally happen among children at Paris from their eating freely of maccaroons, which are sometimes too strongly flavored with the bitter almond."

According to Professor A. T. Taylor (Medical Jurisprudence), the almonds, when eaten in large quantity, have, on one or two occasions, "led to fatal symptoms and death."

When bitter almonds are expressed, they yield a bland fixed oil: and the residuary cake, reduced to powder by grinding, and submitted to distillation with water, gives over a volatile oleaginous product, commonly called oil of bitter almonds. It has a yellowish color, a bitter, acrid, burning taste, and the odor of the kernels in a high degree. Besides a peculiar volatile oil, it contains also hydrocyanic (prussic) acid, and its operation upon the system is closely analogous to this acid. The amount of acid which the oil contains is quite variable.*

Christison says :—

"The essential oil is not much inferior in activity to the pure hydrocyanic acid."

Pereira says :—

"Two drachms [about two teaspoonfuls] of it are said to have destroyed life in ten minutes. The amount of acid in it, and consequently its strength, varies very much."

Stillé (*Therapeutics*) says :—

"The volatile oil of bitter almonds is one of the most powerful of poisons. According to Dr. Taylor, one hundred parts of the oil contain nearly thirteen parts of anhydrous prussic acid. One drop of it is sufficient to kill a cat. This was shown by the experiments of Sir B. Brodie, who also illustrated in his own person its subtle power. Dipping the blunt end of a probe into the essential oil, he applied it to his tongue, meaning to taste the oil, for he had no suspicion that so small a quantity of it could produce any of its specific effects on the nervous system; but scarcely had the instrument touched his tongue when he experienced a very remarkable and unpleasant sensation, which he referred chiefly to the epigastric region. At the same time there was a weakness in the limbs, as if he had not command of his muscles, and he thought that he was about to fall. The sensations were, however, momentary."

* In regard to this point, Pereira may be quoted. He says (Therapeutics), "The crude oil is highly poisonous on account of the hydrocyanic acid which it contains, the proportion of which appears to vary from 8 to 10, or even in some instances to 14 per cent. Göppert obtained as much as 14.33 per cent. in one instance."

Then follow well authenticated cases of poisoning by the oil, which is not worth while to transcribe here, inasmuch as what has already been stated must be sufficient to prove its dangerous character.

With regard to the safety of the oil diluted, as when it is dissolved in alcohol, forming the so-called Essence or Extract of Almond, and Almond Flavor, Pereira says :—

"These names are applied to an alcoholic solution of oil of bitter almonds, which is used by cooks for imparting the flavor of bitter almonds. It is sometimes prepared with the crude oil, and is then a dangerous poison, on account of the hydrocyanic acid which it contains."

In the discussion on the safety of diluting the oil, in Vol. XIII. of the Transactions of the London Pharmaceutical Society, Mr. Edwards, of Liverpool, said that "diluting the oil was not wholly enough; the danger of its use could only be entirely obviated by purifying the oil from prussic acid."

Mr. Nomady thought that the essence was more dangerous than the oil, from its being more palatable, and therefore more likely to be drunk. A case had come under his observation in which a servant, finding a bottle of the essence, which he mistook for noyeau, was instantly killed from tasting it.

A druggist swallowed, by mistake, half an ounce of "Almond Flavor." In half a minute he fell down in a state of syncope; his face being deadly pale, and his pulse imperceptible. Delirium followed, but he slowly recovered from the effects of the poison.

The last paragraph is copied from Taylor's Jurisprudence, where he comments upon the case, as follows :—

"I cannot help remarking, that we have another instance of the disgraceful state of medical police in this country, in the fact that a deadly poison like this is allowed to be sold by druggists for the purpose of giving flavor to pastry and liquors."

As regards this country, the same use of a substance containing an active poison undoubtedly prevails, which prevails in other countries. As regards Massachusetts, it has been determined by direct inquiry, that the unpurified essential oil of bitter almonds, and the extract or essence of the same,

are used by confectioners and other purveyors in Boston, and that the latter form of the article is used to a considerable extent in domestic cookery all over the State.

Very little essential oil of bitter almonds is made in this country for the market, and none at all in Boston. It is nearly all imported, and that which arrives at this port is of Allen's manufacture, which, as has been stated, is found to contain prussic acid. The confectioners generally employ the oil itself. The extract, for domestic use, is prepared for this market by a single firm for the most part. They admit that they use Allen's oil. Their sales are undoubtedly very large, and they assert that no rumors of any deleterious effects from the use of the extract have ever come to their ears. It is believed by them that the alcoholic extract is much safer than the oil on account of its considerable dilution, and that inasmuch as the solvent, alcohol, is of marked pungency, a still greater safeguard is provided. But it has been shown that cases have occurred in which the extract has been drunk under the impression that it was flavored simply with peach-kernels, and that very dangerous symptoms have followed.*

In visits made to confectioners in Boston, it was found that the oil is employed by them whenever peach or almond flavor is desired. Of cakes, the so-called Bridecake is, perhaps, the only kind in which it is used. None of the parties visited seemed to have any fear that harm could follow its use. The almost universal answer was, that so little of it was required to flavor any article, that there could be no possible danger of using it in excess. "One or two drops," it was several times said, "would flavor a large quantity of anything." But this very power of the oil would seem to be the source of danger. If one or two drops go so very far, an additional drop or two must bring the article to which the oil is added near the point of danger. Now, it is notorious that cooks rarely measure the spices, etc., with which they flavor the articles they are preparing. They flavor "by guess," and the habit of confec-

* To make it quite certain that the almond extract of the firm alluded to contains prussic acid, an analysis was made. The quantity examined was the contents of one of the vials in which the extract is usually sold, amounting to two ounces. In this, something more than five-sixths of a grain of anhydrous prussic acid was found. This amount is only a little less than that which, according to Professor Taylor, would commonly suffice to destroy the life of an adult.

tioners is probably the same. And even if carefully "dropped," the risk is not done away with, for, as has been shown, the amount of acid which the oil contains is very variable. But without discussing this point further, it will be sufficient to refer again to the cases of illness which instituted the inquiries of this Report. Here is an admitted instance of too much oil of bitter almonds in ice-cream, followed by annoying, if not dangerous, symptoms, in the individuals partaking of the flavored article.

The question next presents itself, whether there is not some other substance which yields the highly prized almond flavor, and which does not contain any poisonous element. Nitrobenzole has been mentioned as a substitute, but this is of itself, as will be seen in a subsequent part of this paper, a dangerous poison. But cannot the oil of bitter almonds be deprived of its prussic acid and yet retain its peculiar odor and flavor? This is a question which the writer put to himself while making his investigations, but to which he was unable, at the moment, to give an answer. Upon seeking information of others he found that almost every one who dealt in, or used, the oil, was of the opinion that the presence of prussic acid was necessary to the existence of the odor and flavor. The most intelligent druggists agreed with the least informed confectioners on this point, while some of the former were of the opinion that, even if the acid were withdrawn, the oil would still be poisonous even in small doses. A letter from the proprietor of an extensive and reputable druggist's establishment in New York, who was asked if he could furnish the oil of bitter almonds free from prussic acid, contained the following decided language: "There is no oil free from acid. There never was and there never will be. It would have neither taste nor smell." A very different opinion, it was found, was held by chemists who were consulted, and subsequent search in scientific works and journals placed the matter beyond a doubt.

In a lecture delivered in the establishment of the Pharmaceutical Society of London, by Mr. R. H. Semple, on Vegetable Poisons, and which is published in the Transactions of the Society, April 5th, 1854,* the following occurs:—

* Vol. II., p. 29.

"Hydrocyanic acid exists in some plants which are poisonous in consequence of its presence. * * * * The poison procured from them exists in two forms,—as distilled water and as essential oil. Both contain prussic acid. They have a powerful, peculiar and grateful odor, which is usually likened to that of pure prussic acid, but the smell really bears little resemblance to prussic acid, and is not owing to its presence. * * * * The oil is hardly inferior in activity to prussic acid. * * * * But if this oil be entirely freed from the acid, it is not more poisonous than other essential oils, though it still retains its characteristic and grateful flavor. As the oil of bitter almonds is very extensively employed in flavoring articles of confectionery, a German writer suggests the propriety of removing the prussic acid from the oil by repeated distillation with caustic potash, which removes the poisonous ingredient, but does not at all injure its other properties."

In Wood's *Therapeutics*, Vol. II., p. 184, may be read:—

"The oil of bitter almonds consists mainly of hydrocyanic acid dissolved in or combined with a volatile oil, upon which its peculiar odor and taste chiefly depend. When freed from the former ingredient, it has the ordinary properties of the volatile oils, and retains its smell and taste, but is no longer poisonous."

Dr. Hassall, in *Adulterations Detected*, says:—

"There is another compound of prussic acid, called 'Almond Flavor'; it contains about one drachm of the essential oil to seven drachms of spirit, but its strength varies very much. Many fatal cases have resulted from the use of this flavoring substance. The prussic acid in these preparations is not essential to their flavor, and might with a little care be readily separated, so that, as Professor Taylor remarks, in his evidence before the Parliamentary Committee on Adulterations, 'There is no excuse for selling prussic acid in these compounds but laziness and ignorance.'"

In the "London Lancet" of June 21, 1856, is the following article under the heading, "Essential Oil of Bitter Almonds freed from Prussic Acid":—

"The possibility of depriving the essential oil of bitter almonds of the hydrocyanic acid with which it is united in the raw state has long been known, yet this oil, so extensively used by confectioners and others to flavor pastry and similar articles, is still, for the most part, sold contaminated with prussic acid, which adds no advantage in point of odor, and at the same time renders the essence highly dangerous in inexperienced hands."

The article then acknowledges the receipt of a specimen of oil of bitter almonds from Mr. Langdale, a London druggist, which on examination was found to be quite free from prussic acid.

Many other authorities might be quoted to prove that the purified oil possesses the odor of the original oil, among them Göppert, of Breslau, Robiquet, and Boutron-Charlard, Stange and B. Silliman.

But it is even asserted that the flavor of the oil is improved by removing the prussic acid. Mr. W. Price Jones, resident medical officer of University College Hospital of London, in the summing up of the results of some experiments with oil of almonds, which will be presently transcribed from the "London Lancet," says :—

"Besides the invaluable advantage of having the hyduret of benzole (purified oil of bitter almonds) pure, the flavor is far more delicate than that which is commonly sold in the shops as the essential oil of almonds, it being free from the metal-like, bitter taste which is imparted to the latter by the hydrocyanic acid."

What has been said proves that the oil of bitter almonds can be deprived of its prussic acid and yet retain its peculiar taste and smell. It remains to show that the oil thus purified is innocuous, or as much so as other essential oils, all of which are capable, as has been stated, of producing disturbances of the system when taken in certain quantities.

In the "London Lancet" of January 10, 1857, is an article under the caption *Poisoning by Essential Oil of Bitter Almonds—Experiments on Animals*, as follows :—

"The numerous deaths, suicidal and otherwise, that have occurred from the use of the commercial oil of bitter almonds, which is contaminated usually with a considerable amount of prussic acid, have imperatively called for an earnest demand that the legislature should interfere to check the sale of the article in question, unless it be divested of its deleterious ingredient. This is readily effected; several manufacturers actually purify the essential oil of bitter almonds so far as to render it perfectly innocuous, and thus improved it may be obtained in shops as well as the ordinary and injurious article. It is indeed found stated in some old treatises on *materia medica* that the essential oil of bitter almonds (or hyduret of benzole), thus purified, is itself poisonous; and the statement was repeated by a writer in the 'Times' of November 24, last. In order to ascertain the truth by a personal examination, some scientific gentlemen were commissioned by the editor of the 'Lancet' to conduct and witness certain experiments on animals at the establishment of Mr. Langdale of 72 Hatton-Garden, who was one of the first manufacturers of the purified essential oil of bitter almonds. In the presence, therefore, of several gentlemen, some investigations were entered upon by the commission on Wednesday, November last, with results which we proceed to describe. The animals experimented upon were a dog, a cat

and four rats. The greatest care was taken to insure perfect accuracy in the mode of performing the experiments and in the observations made.

"Experiment 1 was with the dog—a young, short-limbed, and strong shepherd's dog. A drachm of Mr. Langdale's *purified* essential oil of almonds was poured down his throat. The animal soon showed symptoms like those of intoxication with ardent spirits, but in a quarter of an hour was able to walk about as usual.

"Experiment 2.—A lively rat was taken out of a cage and held, with mouth open, by a professional rat-catcher, whilst four drops of Langdale's purified oil were dropped from a glass measure into the mouth. This dose appeared to have a very trifling effect; the animal manifested little diminution of activity, did not fall nor show any signs of convulsion. In a few minutes it was put back again into its cage, and long before the termination of the remaining experiments, no persons could have detected from its behavior that it had been itself the subject of one.

"Experiment 3.—A rat, similar in size and activity to the foregoing, was taken out and held in the same manner, when four drops of the ordinary commercial essential oil of almonds were dropped into the mouth from a half-ounce bottle full of that fluid. The animal immediately afterwards manifested convulsive motions, speedily the breathing became laborious, and the rat fell on its side, in which position it continued to lie, frequently subject to violent spasms, until it died in about six minutes and a half after the administration of the poison.

"In experiment 4, a larger rat, to which also four drops of the unpurified oil, but containing less prussic acid, were given, died in fifteen minutes.

"In experiment 6, half a drachm of Langdale's purified oil was given to a cat of moderate size. The effect was much the same as with the dog, and the animal, in four minutes from the administration of the oil, had to all appearances wholly recovered.

"The instances above cited have proved the following facts:—that of Langdale's purified essential oil of almonds, one drachm administered to a middle-sized dog, half a drachm to a cat, and four drops to a rat, were incapable of destroying life, while four drops of the ordinary essential oil of almonds killed a rat in two instances. * * * * Although not fatal in its effects, the purified essential oil of bitter almonds, like other essential oils, cannot be swallowed in its undiluted state with perfect impunity to the digestive organs, any more than alcohol or cayenne pepper. No doubt, in doses of a drachm, or half a drachm, it is calculated to produce an inflammatory condition of the mucus lining of the alimentary canal. It is highly pungent, and a drop placed on the tongue produces a sensation very analogous to that occasioned by tincture of iodine similarly applied; and it cannot be properly employed in confectionery except when diluted with alcohol, in which it is perfectly soluble. Other essential oils, in large doses, have proved fatal to animal life from their stimulant effect."

In proof of this latter statement some experiments by Mr. W. Price Jones are given, and the results are thus summed up by him :—

"From the results of these experiments I conclude that, notwithstanding a large quantity given to a small animal, proved, in one instance fatal, the *purified* oil of almonds cannot be regarded as a poisonous substance, and that

it is at least as harmless as oil of caraway, which may be fatal when given in an inordinate dose."

No well-grounded objection can probably be made to the purified oil or to its alcoholic solution. Some fear has indeed been expressed that both forms would, after a time, lose their flavor by being oxidized, the result being the formation of benzoic acid; but Messrs. Preston and Sons, in a note to the editor of the "Pharmaceutical Transactions" (Vol. VI., p. 435), assert that they have kept specimens of each exposed to the light and air for a long time, without any change whatever taking place in them.

After what has been said, the natural question arises, if legislation ought not to interfere to forbid the indiscriminate use of so powerful a substance as the unpurified oil of bitter almonds. It has been more or less prescribed by physicians on account of the prussic acid it contains, which has valuable medicinal qualities, but even physicians now rarely use it, because the amount of acid which the oil contains is so variable: they prefer to use the acid itself, in the officinal diluted form, the strength of which is known. Pereira says: "In this country" (England) "essential oil of bitter almonds is not employed in medicine."

Calls for legislation concerning this oil have long been made in England. In a leading article in the London "Lancet" of June 21, 1856, occurs the following:—

"The agreeable qualities of this liquid render it peculiarly dangerous, and it is therefore an article which ought by every means to be prevented from reaching the hands of those not fully acquainted with its noxious properties when administered in excess. It does not augment the enjoyment of a festive occasion to know that the custards, pound-cakes or sweetmeats set before us may carry with them death or danger. * * * * When it has been proved incontestably that science is capable of securing all the desirable qualities of a substance, free from the admixture of a chemical compound of a most dangerous and powerful kind, there ought surely to be a prohibition against the sale of the article which is not deprived of the deleterious admixture."

In an article of similar tenor in the issue of January 10, 1857, the same journal gives an idea of the amount of oil used for flavoring purposes annually in England:—

"It is estimated that about eight thousands pounds of the ordinary essen-

tial oil of almonds are manufactured and delivered for the retail British trade annually. Since the introduction of the cheaper nitro-benzole into the manufacture of perfumes, the whole of the above large quantity is destined to be eaten or drunk in some shape."

No attempt has been made to determine the amount of the oil used in this country, but there arrived at the port of Boston during the year 1871 one hundred and forty-nine pounds, equal to about the same number of pints. This is rather below than above the average yearly importation. Of these one hundred and forty-nine pounds or pints, forty-nine pounds were consigned to three of the wholesale druggists of Boston, and by far the greater portion of this amount was, or will be, used for flavoring purposes, either as the oil itself or as the alcoholic extract.* Of the oil of bitter almonds less than a teaspoonful has destroyed the life of an adult. Two teaspoonfuls will, in the majority of cases, prove fatal. We have therefore in the forty-nine pints of oil, about 2,750 fatal doses.

It may not be out of place to state what became of the additional one hundred pints of oil, containing 5,500 fatal doses. This quantity was consigned to a manufacturer of a patent medicine.

Nitro-Benzole, or Oil of Mirbane.

Nitro-benzole, or oil of mirbane, is the result of the action of nitric acid on benzole, which is one of the lighter products of the distillation of coal-tar. It is characterized by having an odor closely resembling that of the oil of bitter almonds, and it has, therefore, sometimes been called the artificial oil of bitter almonds. It is principally used in the manufacture of aniline colors and for scenting soap and perfumery. It is also said to be used to some extent by confectioners, on account of its cheapness, compared with the oil of bitter almonds. Although it is not, like the latter substance, contaminated with prussic acid, it is nevertheless a very active agent, and cases of death are on record after swallowing a very

* This statement is given on the authority of druggists. In answer to a question as to the probable destination of the oil sold by them, one said, "Probably not over a pound of it was used in medicine." And another, "Very little indeed of it went into prescriptions."

few—eight or nine—drops of it. Moreover, it is very dangerous when its vapor is inhaled for any length of time. Several deaths have occurred from this cause, one case being in Boston.*

With regard to the use of nitro-benzole for flavoring purposes in this city and State, it is not believed that a great deal is so employed. At all events, none of the confectioners visited by the writer admit using it, and none has been met with on sale at grocers or druggists. The opinion of one of the proprietors of the largest manufacturing coal-oil establishment in Boston, where nitro-benzole is made to some extent, is that this substance is very little employed for flavoring purposes by purveyors to the public, in this city at least. Neither does he know of its being sold for this purpose here. On the other hand, a well-known manufacturing chemist asserts, in a letter to the writer, received late in the preparation of this Report, that nitro-benzole "has been to a considerable extent substituted for the essence of bitter almonds, in the manufacture of sirups, cake, candies, &c. It has a regular sale, but how extensive it is I cannot state positively." It is possible that further search in obscure localities in this city, and in the country, may reveal its employment, as a flavoring substance, to some extent.

The Artificial Fruit Essences.

The compound ethers which have been found to possess the odor and flavor of certain fruits, are several in number.

Butyric Ether.—This ether may be prepared by mixing butyric acid with sulphuric acid (oil of vitriol) and alcohol. The former acid may be made by mixing decaying cheese with grape-sugar and chalk and allowing fermentation to take place. The ether is dissolved in another portion of alcohol and forms the pine-apple essence.

Pelargonic Ether, *Œnanthic Ether*, may be prepared by digesting pelargonic acid with alcohol at a gentle heat. The acid is the result of the action of nitric acid (aqua-fortis) on oil of rue. The ether is dissolved in alcohol and forms the quince essence.

* Boston Medical and Surgical Journal, January 18, 1872.

Acetate of Amylic Ether is prepared by distilling a mixture of fusel oil, acetate of potash and concentrated sulphuric acid. An alcoholic solution of the ether forms the Jargonelle pear essence.

Valerinate of Amylic Ether may be made by the action of sulphuric acid and valerianic acid upon fusel oil. An alcoholic solution of this ether forms the apple essence.

A mixture of acetate of amylic ether with butyric ether forms the banana essence.

Other mixtures of the ethers, modified by the addition of various agents, as nitrous ether, acetic acid, camphor, tincture of orris, vanilla, the volatile oils, &c., result in imitations of other fruits, the strawberry, raspberry, apricot, currant, &c., &c.

Are these artificial fruit essences deleterious to health? A succinct answer to this question cannot properly be given. If taken into the stomach in any considerable quantity, and in an undiluted form, the effect would, without doubt, be not simply deleterious but highly dangerous. But, in the form in which they are presented in confectionery, &c., they are more or less diluted; the chance, therefore, of harm following their occasional use is greatly lessened. But even when diluted, habitual indulgence in them, according to the opinion of scientific men, cannot fail to be injurious to health. And deleterious results may follow their occasional use, even when in the diluted form; this may happen in the case of adults, on account of a peculiar idiosyncrasy. And in all cases, probably, children are more susceptible to their influence than adults. Children are also more likely than adults to partake largely of confectionery, and a free indulgence in articles of this kind, in a season of the year when disorders of the intestinal canal are prevalent, has been known to bring on such disorders, or to aggravate them when existing. It is, however, sometimes the case that sufficient dilution of the flavoring ether has not been made, and alarming consequences have attended such carelessness. The writer was informed by a distinguished chemist and physician, that, within his personal knowledge, two children—one of them, indeed, his own child—were seized, after drinking the liquid contained in a hollow toy, candy-anchor, with alarming sedative symptoms, requir-

ing active medical treatment. Enough of this liquid was secured to prove that it was flavored with the artificial pine-apple essence.

When these essences first came into use, confectionery flavored with them was exceedingly popular; but it was not long before it became so evident that indulgence in such confectionery was attended with evil results, that caution was given in the newspapers of the day, and the sale of the "fruit-drops," &c., greatly diminished.

Dr. Hassell, in his *Adulterations Detected*, says: "Many articles of sugar-confectionery are flavored with 'essences' which are often of an injurious and even dangerous character, some of them containing prussic acid and fusel oil."

"I have heard," says Professor A. S. Taylor, "that some of the Jargonelle pear-drops and the ribstone pippin-drops have produced drowsiness and stupor in children. It is an imposition on the public to sell in this way a chemically flavored substance under another name."

As regards the use of these artificial fruit essences, it is an undoubted fact that they are very extensively employed everywhere, for flavoring jellies, confectionery of various kinds, and sirups for soda-water. They are also used in the manufacture of factitious wines and other alcoholic liquors. They are found to be less adapted to ices than to the other articles mentioned, and are probably used in them to a very limited extent, and not at all by confectioners of any repute.

The following are some of the results of inquiries at confectioners' establishments in Boston:—

F.—A confectioner in excellent repute; makes ices and cakes principally; some candies. Never uses the artificial essences. Has a limited number of flavors.

M.—Ditto; ices and cakes principally. No artificial essences. Flavors limited in number

W.—Ditto. Ditto. Ditto. Ditto.

C.—Ditto; ices, cake and candies. No artificial essences. Flavors limited in number.

C.—Ditto. Ditto. Ditto. Ditto.

P.—Cheap ices only. No artificial essences. Is enabled to sell cheaply on account of simplicity of materials used, and extensive sales.

S.—Large manufacturer of candies only. In good repute. Uses the artificial essences to some extent. Desires to have a good list of flavors, and finds it difficult to use fruit-juices in any but soft candy, on account of their

watery element. Does not know of harm resulting from the use of candy artificially flavored.

J.—Extensive manufacturer of popular candies, sold principally in the street and in places of public resort, railroad stations, etc. Uses the artificial essences exclusively, for fruit flavors. Manufactures the essences himself, from the best materials. They cost him nearly twice as much as those which he formerly bought, and which are used to a great extent by imitators of his candies. Thinks the cheap essences are bad, but has a very different opinion of those made by himself. "If a child, who was about to be ill, should eat candy of my manufacture, it might do harm, but so would a piece of cake eaten under such circumstances." Does not care about using the artificial flavors: would make more money to limit the flavors to the essential oils if he could sell the same amount of candy, because the oils are cheaper; but people like the taste of fruit flavors, and his sales are correspondingly increased.

In the perusal of the above, it will be perceived that the ices are uniformly pure, as far as the artificial essences are concerned. The list of fruit flavors was very limited. As regards candies, the list of flavors varied in extent, and whenever it included many of the fruits, artificial essences were invariably used. The compound ethers seem to produce an unpalatable change in some of the usual ingredients of ices, and they are, consequently, not much used therein. In candies, however, no similar change seems to take place, and as the juices of such fruits as the strawberry, raspberry, pear, banana, etc., etc., are not easily manipulated in sugar, and must, moreover, be preserved, to be used out of season, at considerable expense, the artificial essences have, for the most part, taken their place. Almost all the candy in the market, therefore, bearing the flavor of the easily perishable fruits, is prepared with the artificial fruit essences.

The extent to which the compound ethers are employed in the sirups which are used with soda-water, so called,* will appear from records of visits made to druggists and apothecaries. To avoid repetition, mention will also be made here of the method of flavoring lemon and sarsaparilla sirups.

M.—Druggist and apothecary in excellent repute; does not use the artificial essences. List of flavored sirups limited to raspberry, pine-apple ginger, lemon and sarsaparilla. Makes the first two of fruit, and of sufficiently heavy body to keep well. The lemon sirup is difficult to keep;

* "Soda-water" is simply water charged with carbonic acid gas.

uses therefore citric acid and oil of lemon. Sarsaparilla, of itself, has little flavor; adds therefore the oils of wintergreen and sassafras.

B.—In good repute; has coffee, raspberry, strawberry, pine-apple, lemon and sarsaparilla sirups. The raspberry and pine-apple are made from the fruit. The strawberry is made by adding the essence of strawberry to the raspberry sirup. Lemon, made of citric acid without addition of oil of lemon. Sarsaparilla, flavored with oils of wintergreen and sassafras.

B.—Ditto; has a good list of flavors, as to number, and in all cases from the fruit kept hermetically sealed. Lemon is of citric acid and oil of lemon. Sarsaparilla, made as by the two preceding druggists.

L.—Ditto; a good list; all fruit. Strawberry of equal parts raspberry and pine-apple. Lemon and sarsaparilla as before.

C.—In fair repute; a pretty good list. Pine-apple from the fruit. Raspberry bought in sirup, heavily flavored and probably artificial. Strawberry, a mixture of raspberry and pine-apple. Lemon, of citric acid and oil of lemon. Sarsaparilla, of molasses and water flavored with the oils already mentioned.

A.—In quite moderate repute; a pretty good list; all fruit. Sarsaparilla as before. Lemon, of tartaric acid and oil of lemon.

J.—In little repute as an apothecary; deals mostly in perfumery and toilet articles. Record much as J's. except citric acid in the lemon sirup.

K.—Repute as preceding; makes a specialty of dispensing "cream-soda." A very large list of flavors. Uses the artificial flavors exclusively. Cannot use fruit because their acids curdle the milk and injure the appearance of the beverage. Customers cannot distinguish the artificial from the true fruit flavors.

In addition to the druggists and apothecaries mentioned, two other establishments were visited; one where the soda-water fountains are charged with their contents, and where sirups are made, and another where the apparatus for dispensing the soda-water is extensively manufactured, and where sirups are also prepared. At the first named, sirups are made principally for the country, and for street stands, railroad stations, and other public places in the city. The only sirup made from the fruit is pine-apple. The other fruit flavors are made from the artificial essences. Lemon is made of tartaric acid and oil of lemon.

At the second establishment the sirups are of both kinds, from the fruit and artificially flavored. The pure juice of fruits is also sold for mixing with simple sirup. The proprietor thinks that, as general thing, the real sirups give better satisfaction, although, for the most part, consumers cannot distinguish between the two. The pure sirups are pretty generally used in the city and those artificially flavored in the country.

Letters have also been received by the writer of this Report from establishments at a distance, in answer to inquiries concerning the use of the artificial sirups.

M.—Of New York, writes: "Imitation fruit sirups are commonly used, and, when properly made, are often preferred to pure fruit."

F.—Of New York, writes: "We send enclosed price list of our flavors, which are in *general* use. We have not got the real fruit sirups."

It will be noticed that, although the use of the artificial essences in soda-sirups is common enough, as a general thing the druggists and apothecaries do not use them to a great extent. Those of the best repute probably do not use them at all. They all agree in using citric or tartaric acid in place of lemon juice, on account of the difficulty of keeping pure lemon sirup for any length of time. Both citric and tartaric acids, however, are true fruit acids, the former coming from the juice of the lemon and the latter from cream of tartar, which is a deposit from wine. If used in the proper amount, neither of these acids can be deleterous in an occasional summer beverage. Except in one or two instances, the lemon sirup was still further approximated to the genuine article by the addition of oil of lemon.

Without exception the oils of winter-green and sassafras were added to the sarsaparilla sirup to supplement the flavorless preparation of that root. Oil of anise is said to be sometimes used in addition to the two oils mentioned. In one instance, there was no sarsaparilla whatever in the sirup bearing that name, which was simply molasses and water flavored as usual. Probably the greater part of the so-called sarsaparilla sirup dispensed with soda-water in obscure parts of the city, and at the smaller apothecaries everywhere, is quite innocent of the famous root. It is the "fountains" in just these localities that are visited by the class of persons, who periodically think that their blood is "out of order," and who select sarsaparilla sirup with the object of purifying it, drinking the beverage with the most undoubting faith in its virtues.

It may be mentioned that, where the essences are used in the sirups, a small portion of either citric or tartaric acid is used to give a slightly tart taste. Where, also, the sirup is

to represent the flavor of any of the red fruits, as the strawberry, for instance, coloring matter must be added. This is generally made of cochineal. The sarsaparilla sirup, also, generally receives a little coloring, except when molasses is used, and the coloring substance is caramel.

The following directions for making strawberry sirup are taken from the "Descriptive Catalogue" of an extensive manufacturer of soda-water apparatus. Many others are given :—

"*Strawberry Sirup*,—made without the fruit;—add to one gallon simple sirup, two teaspoonfuls of essence of strawberry and a quarter of an ounce of tartaric acid. Color with coloring made as follows: Boil one ounce of cochineal with half a teaspoonful of cream of tartar; strain."

Employment of the Artificial Essences in Fruit Jellies.

In one of the March, 1872, issues of the *Scientific American*, a correspondent inquired the method of manufacturing fruit jellies. Answers to this question appeared in subsequent issues of this journal. One of them, in the issue of April 6th, reads thus :—"Fruit jellies are simply gelatine dissolved in water, colored, and flavored with the so-called 'flavoring extracts.'" A second answer reads thus,—"Fruit jellies, so called, are made by putting half an ounce of alum in one pint of water; let it boil a minute, or till dissolved, then add four pounds white sugar; boil two minutes longer, and strain; when cool, add half a two-shilling bottle of vanilla, lemon, or strawberry extract, or other flavor."

Still a third answer, in the issue of April 27th, reads,—"Fruit jellies are made of sweet unfermented cider boiled in sugar to the consistency of jelly, flavored and colored to taste."

These directions, which differ from the processes employed by house-keepers, who are in the habit of using currants when they wish to make currant jelly, quinces when they desire quince jelly, etc., etc., suggested inquiry into the character of the fruit jellies made for sale in Boston.

It was learned from a confectioner of good repute, who makes jellies in small quantities, that currant jelly, for instance, cannot be sold, at a profit, for much less than fifty

cents per eight-ounce tumbler. It was also learned, from a manufacturer of jellies on a large scale, that when thus made, this jelly ought to sell at from forty to fifty cents. "We make," said he, "a jelly with a basis of apple jelly,—say two-thirds of the whole amount,—with the remainder of currant. This sells at a less price, but it is not called currant jelly, but "Pomona." It is of a much lighter color than currant, and has, of course, much less flavor."

It was inferred from these inquiries, that currant jelly, of deep color, which could be sold at less than forty cents per eight-ounce tumbler, must be made of something besides the pure fruit. A visit was next made to C Street, which contains a considerable number of grocer's establishments of the second-class, and at every one visited, some ten or twelve, currant jellies, of a deep color, were selling at from twenty to twenty-five cents per eight-ounce tumbler. In addition to this variety, jellies of many other fruits (or so labelled) were selling at the same price. The names and addresses of several of the manufacturers of these jellies were taken, and three of them were visited. The result of the interviews is here given :—

P.—Formerly kept jellies from the pure fruit, but found it didn't pay and now keeps none at all. Those now kept are made from apples, properly colored, and flavored with the artificial fruit essences bought in New York. Pays the highest prices for these essences. The jellies cannot be distinguished, by customers, from those made from pure fruit; the latter are really no better. They retail at from twenty to thirty cents per eight-ounce tumbler, according to the locality of the retailer. Keeps currant, raspberry, strawberry, blackberry, peach, quince, crab-apple, pine-apple and grape."

The currant jelly was tasted at this place. The taste decidedly resembled the currant flavor, so that it would generally pass for the genuine article; the substance of the jelly seemed, however, to lack firmness.

In an advertising circular issued by P's establishment, "the special attention of dealers, hotels, restaurants, and families is invited to the large and varied stock of preserves in bulk, stone pots, and glass, which for purity and richness of flavor are unequalled by any in the market."

R.—Makes his jellies of apple, flavored with the artificial essences, with two exceptions, viz.: crab-apple and grape; these are of pure fruit. Keeps

strawberry, raspberry, blackberry, cranberry, barberry, quince, peach, currant, apple, crab-apple, pine-apple and grape. They will retail at about twenty-five cents. Uses a little fruit (citric or tartaric) acid in some jellies. It is difficult to distinguish the artificial from the genuine unless "one has experience."

C.—Makes jellies from the fruit and also from apple artificially flavored. Consumers can't distinguish between the two. The artificial sells for twenty-five cents per tumbler. (The list at this establishment includes black currant and plum.)

It thus appears that large quantities of spurious jellies, artificially colored, and flavored with the artificial fruit essences, are made and sold in Boston. If it is, as Professor Taylor justly says, an imposition to employ these essences in confectionery, what term ought to be applied to their employment in fruit jellies which are so much used by sick persons? But it is, undoubtedly, a subject for congratulation that apple, and not glue, forms the basis of these jellies, and that alum does not probably enter into the manufacture, except so far, perhaps, as is necessary in the preparation of the coloring matter.

This coloring matter is generally the same substance as that used in soda-sirups, namely: cochinéal, which, it may be stated is, of itself, harmless enough. In the circular of a prominent manufacturer of "Extracts for Cooking" in this city, may be read,—"Extract of Cochineal—For giving a fine red tint to jellies, etc."

Employment of the Artificial Essences in Alcoholic Liquors.

The artificial essences are employed, to a greater or less extent, in factitious wines and other alcoholic liquors, and are generally kept for sale, for this purpose, by what are known as Brewers' Druggists. This class of persons made its appearance years ago in Europe, and flourished especially in England. Hassall says of these druggists: "These persons issued regular price-currents, and they made it their business to send travellers all over the country, with lists and samples, exhibiting the price and quality of the articles manufactured by them." The substances sold for flavoring and giving strength to alcoholic liquors were, according to Hassall, cocculus indicus, grains of paradise, capsicum, ginger, quassia, wormwood, calamas root, caraway and coriander

seeds, orange powder, liquorice, honey, sulphuric acid, cream of tartar, alum, carbonate of potash, hartshorn shavings, nux vomica, gentian, chamomile, tobacco, opium, orris root, juniper berries, angelica root, and bitter almonds.

To this list modern chemistry has added many of the compound ethers.

While searching for materials for this Report, a circular fell into the writer's hands, the introduction of which was as follows :—

Important Information for Practical Men.—Eichler's Receipts for Liquors, Sirups, Bitters, &c., will save hundreds of dollars, which you are now paying to others for preparing your Whiskeys, Brandies, Gins, &c. These receipts embrace the most concise, accurate and practical directions for the convenient preparation of the various beverages, in large and small quantities. But one receipt is given for each article, so that there is no need of expensive experimenting. The ingredients recommended for flavoring and coloring are all easily procurable, perfectly harmless and can be used with the utmost confidence. Special care has been taken to so arrange the receipts, that no expensive apparatus is necessary. In fact, the majority of all the formulæ may be prepared by simple mixing.

Liquors made according to these receipts so closely resemble the genuine that they often cannot be distinguished. They answer for all the same intents and purposes, as the flavors for preparing them are identical with those which are formed naturally during fermentation. Modern Chemistry, which has by analysis discovered the existence of these ethers in Wines and distilled Liquors, has also found other more abundant sources for them, rendering it highly advantageous to employ the latter.

Communication was established by the writer with the druggist who issued this book of receipts, and the work was obtained. A few of the receipts are here given.

Irish Whiskey.—Concentrated essence Irish whiskey, one-quarter pint; age and body preparation, one pound; pure rectified spirts, forty gallons.

To improve the above, add five gallons genuine Irish whiskey.

Improved Corn Whiskey.—Sweet spirits of nitre, two ounces; acetic ether, one ounce; age and body preparation, one pound; corn whiskey, forty gallons.

New York Whiskey.—Concentrated essence Bourbon, four ounces; compound tincture of green tea, one pint; tincture of capsicum, one pint; tincture of grains of paradise, one pint; corn whiskey, twenty gallons; water, twenty gallons.

New England Rum.—Concentrated essence New England rum, one-half pint; rectified spirits, or molasses whiskey, forty gallons.

Santa Cruz Rum.—Concentrated essence Jamaica rum, six ounces; concentrated extract vanilla, four ounces; brandy coloring, one pint; age and body preparation, one pound; rectified spirits, or molasses whiskey, forty gallons.

To improve the above, add a strained decoction of two pounds St. John's bread, two pounds raisins, one pound figs, in two gallons water.

Auction Brandy.—Brandy flavor, one-quarter pint; tincture of green tea, one pint; tincture of capsicum, one pint; tincture of grains of paradise, one pint; age and body preparation, one-half pound; rectified spirits, ten gallons; water, ten gallons; brandy coloring, sufficient.

French Brandy.—Brandy flavor, one-half pint; age and body preparation, one pound; brandy coloring, one pint; pure rectified spirits, forty gallons.

If wanted for immediate use, double the above proportions must be used. To improve the above, add about five pounds each of bruised raisins and St. John's bread to each barrel.

Port Wine.—For forty gallons. Port wine ether, four ounces; aromatic tincture, eight ounces; tincture of rhatany, eight ounces; tincture of orris, twelve ounces; simple sirup, three gallons; rectified spirits, three gallons; wine coloring, two gallons; plain or raisin wine or fermented cider, thirty-two gallons.

To improve the above, add five gallons imported port wine. Instead of the wine coloring, either elderberry, cherry or huckleberry juice can be used, wholly or in part.

Cheap Port is like the above, except that the orris is omitted, fruit acid added, the wine and cider omitted and replaced by water, and the spirits increased.

Madeira Wine is made of Madeira ether, tincture of rhatany, fruit acid, brandy color, simple sirup, rectified spirits and water.

London Sherry, of picked and crushed raisins, simple sirup, white argols, cider, soft water, rectified spirits, and fluid extract of wild cherry.

Imitation Champagne, of sugar, water, white argols, sweet cider, yeast: and when fermentation commences, add rectified spirits and tincture of orris.

Imitation of Claret, of fermented cider, rectified spirits, simple sirup, clear water, wine color, tincture of catechu, tincture of orris and fruit acid.

Hop Beer, of molasses or simple syrup, fluid extract of hops, water and yeast.

Leave the bung out for about twenty-four hours, or until the main fermentation is over; then close the vessel. The beer can be used after about three days.

Sweet Apple Cider, of brown sugar, cider flavor, and water. Yeast is added to produce fermentation. To improve the article add rectified spirits. To give it a champagne taste, add two or three bruised raisins.

The above are only a very few of the receipts, which number over two hundred.

The flavors and ethers mentioned are sometimes mixtures of two or more of the compound ethers, experience teaching the "druggist" the kinds, and the proportions of each kind, necessary to produce the taste of the wine or other liquor it is desired to imitate.

The question naturally arises if these factitious liquors can possibly be palmed upon any persons as genuine. A letter on this point from the druggist who issued the receipts, reads as follows:—

"PHILADELPHIA, Dec. 10, 1872.

"——— ———, Esq.

"DEAR SIR:—We are in receipt of your favor of this date. In reply we would state that good judges of liquor could of course detect the difference between genuine imported liquors and those artificially flavored, though it is very difficult for any one but a first-class judge to distinguish them. They are sold by the greater part of the trade whenever medium or lower price goods are wanted. They improve very much by age. We think you would have little difficulty in selling them to all except your very finest trade.

"We make a specialty of keeping all kinds of drugs, &c., for liquor dealers.

"We remain, very truly, yours.

"——— ———."

It is considered unnecessary to discuss the question if these factitious liquors are deleterious: it is, however, important to know if they are made and sold in this city and State.

For information on this point, the writer has depended upon the statement of persons who have had occasion, in an official capacity, to test the character of alcoholic liquors sold in Massachusetts.

It appears to be true that the greater portion of the impure alcoholic liquors sold in the State, is adulterated by the addition of alcohol and water only. The artificial liquors are manufactured by a limited class of persons. These are not, generally, the wholesale dealers nor the better portion of the retail dealers, but the lowest class of the latter, in the obscure parts of the cities, and in the smaller towns, where the number of such manufacturers is proportionately larger, probably, than in the cities.

TARTARIC ACID AS A SUBSTITUTE FOR FRUIT.

It has already been noted that tartaric acid, and also citric acid, are employed as a substitute for lemon-juice in the

manufacture of lemon sirup, and that they are sometimes used to give tartness to jellies artificially flavored. But tartaric acid is sometimes also employed as a substitute for fruit in pies and tarts, and it is now, in this vicinity at least, put up in boxes and sold for this purpose under the name of "Fruitina." It may be found upon the counters and shelves of many of the grocers of this city, and is recommended in the following terms :—

Important to Housekeepers.—Found in Fruitina, a perfect substitute for fruit for all kinds of pies and jellies! Twenty-five pies for thirty-five cents! One package will make twenty-five pies that cannot be distinguished from those made of fruit, mince, apple, lemon or pumpkin. The jellies made of Fruitina are unsurpassed for beauty, transparency, richness and freshness of flavor. It saves all the labor of preparing the fruit and is far cheaper. The cook will be delighted with it because the baking is so quickly accomplished. Try one package and be convinced of its wonderful merits. Warranted to perform all that is promised for it. One package makes twenty-five pies or sixteen pounds of jelly. Price thirty-five cents per package. Full directions accompany each box.

Sold wholesale by Henry W. Putnam, Oxford, Mass.

P. S. Warranted free from injurious ingredients.

For sale by all grocers.

Read! Read! Read! A Card to the Public.—This preparation is wholly composed of fruit and vegetable substances, and is warranted to contain no injurious ingredients, and to be perfectly harmless. The money will be refunded, if in any case, after thorough trial, satisfaction is not given.

Read the following notices from the press:—

An agent for H. W. Putnam, of Oxford, Mass., is introducing to the notice of our citizens, a new article in the way of a substitute for fruits for all kinds of pies and jellies, &c. We have tested its merits and are satisfied that it is as good, if not a little better, than the real thing. [*Nashua Daily Telegraph*, Dec. 20, 1871.

We wish to call particular attention to a new substitute for fruit in cooking, advertised in this paper, put up by Henry W. Putnam, of Oxford, Mass. In order to satisfy ourselves as to the merits of this preparation before recommending it, we procured a box and submitted it to trial under the direction of an experienced cook. We can truthfully say that the trial was in every way satisfactory, and we are willing to stake our reputation on the merits of Fruitina. [*Douglas Herald*, Dec. 30, 1871.

See the following testimonials:—

We, the undersigned, have thoroughly tested the merits of Fruitina, and it has proved in all respects satisfactory. We recommend it to the public as a perfect substitute for fruit.

Here follow some forty names of women, several of whom are represented as keeping boarding houses. There is also one "proprietor of dining-rooms."

"Directions for using" accompany each box of "Fruitina," and it is worth while to copy one or two of them.

Apple Pies.—Dissolve one teaspoonful of Fruitina and one cup of sugar in two cups of cold water. Have ready three plates lined with crust, and fill with the mixture. To each plate add one cracker, broken in pieces about the size of slices of apple; add salt and any spice you prefer; cover and bake.

Pumpkin Pie.—Three tablespoonfuls of molasses, a quarter teaspoonful of Fruitina, one quart of milk, two eggs, three rolled crackers; then add spice, and sweeten with sugar to your taste.

Jellies.—Four heaping tablespoonfuls of common starch and one teaspoonful of Fruitina, rubbed smooth in a little cold water; add one pound of sugar, and pour over it, stirring rapidly, one pint of boiling water; let it boil gently about ten minutes, taking care that it does not burn; remove from the fire and flavor with anything you prefer. Pour in moulds and cool. The above quantity of starch may not always be found correct, as there is a great difference in the gluten of the article. Jellies made from this recipe are fully equal in every respect to those made from fruit at far more expense and labor.

This use of tartaric acid has undoubtedly been stimulated by receipts, in which it enters as an ingredient, which have appeared from time to time in farm journals and other publications. Within a short time one of these receipts was met with in a weekly publication in Boston. Under the head of "Our Recipes," which included "Mackerel Pudding," "Rich Cake without Eggs," and a Yorkshire receipt called "Fat Rascals," is one for "Imitation Lemon Pie,"—"A very good imitation, so far as taste is concerned, of a lemon pie, can be made as follows: Pare and boil a turnip, add a teaspoonful of tartaric acid, and a cup of sugar; season, and bake as an apple pie."

Tartaric and citric acids cannot be considered as poisons, and they may be swallowed in considerable quantity without fatal results. Moreover, as has already been intimated, they may, dissolved in a proper amount of water, be taken occasionally in the hot season, with advantage. They also make a refreshing drink in fevers. It is, however, a cheat to use either of them as a substitute for fruit in the domestic economy, and it is not unlikely that they may do harm if partaken of too freely.

There some other substances which are occasionally used as flavors in articles of food and drink, in this vicinity as elsewhere,—but they are generally employed with the tacit

consent of the consumer and are, also, not injurious. Vanilla in chocolate and sage in cheese may be mentioned as examples. In other cases, substances are employed without the tacit consent of the consumer. Of these liquorice in the extracts of coffee and in beer may be mentioned. The former flavoring adulteration is very common, the latter rare.

It may be well to notice the commonly entertained opinion, that strychnine is often used to give a bitter flavor to ales and beer. The writer has made some effort to determine this question, and the result of his inquiries is his belief that the popular idea is entirely erroneous. It is probable that in no brewery in this country is any other substance than malt, hops, and water employed in the making of beer, if the very rare use of liquorice may be excepted. As regards the ales which are imported from England, it is an established fact that they are absolutely pure. Some years ago, on account of accusations made by certain persons in France, two of the largest manufacturers of ale in England invited an examination into the character of their productions, with special reference to the presence of strychnine. The strictness of the investigation was such as to preclude the possibility of error, the specimens of ales analyzed being obtained in various parts of the kingdom, and the brewings bearing various dates, all previous to that of the appearance of the accusations. The examiners were chemists nominated by "The London Lancet," and the verdict was that hops, malt, and water alone were employed in brewing the specimens of ale examined. The ales of these two establishments are more largely imported into Boston than those of any other foreign brewery.

Spontaneous Change in the Extract or Essence of Vanilla.

The vanilla-flavor, so much used and so highly prized, is given to articles of food in two forms; first, in that of a powder of the pod; and secondly, in that of its alcoholic extract. There is no reason to believe that either the pod itself or the extract is deleterious when fresh, but there is strong reason to fear that the extract, at least, may undergo a change so as to be capable of producing poisonous symptoms. What this

change is, is not yet known, but it probably takes place through oxidation, after exposure for a length of time to the air.

The following is from the "Medical and Surgical Reporter," date unknown :—

"The German medical journals call attention to the circumstance, that several cases of poisoning by vanilla-ices have in late years occurred in Paris, Altona, Munich, Vienna, and other places. Maurer has recently related an instance in which, after the use of these ices, a large family suffered from the symptoms described as having been present in the other cases, viz., frequent vomiting and diarrhœa, assuming in some of the patients a choleriform character. All the patients recovered. What the nature of the poison is has not yet been ascertained. In two observations on the remaining portions of the poisonous ices traces of lead, iron and tin were present; * but the combination of lactic acid with oxide of tin has been ascertained not to be poisonous. Schroff believes that the poison is produced by the use of cashew-nut oil to besmear the vanilla-pods."

The following account is from the "Boston Medical and Surgical Journal," of June 27, 1872.

"*Poisoning by Vanilla-bean.*—Messrs. Editors,—In the 'Journal' for May 30th there is an extract from the 'Medical and Surgical Reporter,' on poisoning by vanilla flavoring. It is there stated that Schroff believes that the poison is produced by the use of cashew-nut oil to besmear the vanilla-pods.

"Having been poisoned myself a few years ago,—together with eight or nine other person in my family,—by 'the extract of vanilla,' I was led to institute inquiries as to the cause, and arrived at a different conclusion from the above. The food which sickened those of my family who ate of it was custard flavored with the extract of vanilla. The bottle from which the extract was taken had been opened some months previously, and a part of it used at that time without producing any ill effects.

"By inquiring among my friends, I learned that one of them, together with a large family of which she is a member, had been poisoned by food flavored with vanilla-extract, which was stale, and which had been exposed to the air for some time.

"As the same manufacturer's extract of vanilla had been used in my family for years without bad effects, and a portion of the same bottle had been consumed some months before without producing any sickness, and as we have since used the same flavoring for ices and food, prepared by the same parties, taking care only to use it fresh, and only in the above instance have been made ill by it, I have come to the conclusion that a change takes place in the extract when exposed for a time to the air, and that this develops some poisonous properties. HAMPSHIRE."

* Probably from minute particles of the soldered tinned-iron vessel in which the ices were made. Such particles are undoubtedly present in all ices in infinitesimal amounts.

It is not generally known that the low-priced extracts of vanilla in the market are made, wholly or in part, of the tonka-bean, a cheaper article which is somewhat used for flavoring snuff. There is, however, no reason to suppose that this bean possesses any deleterious properties.

BOSTON, December, 1872.

DRAINAGE FOR HEALTH.

By HENRY F. FRENCH, of Concord.

DRAINAGE FOR HEALTH.

It appears from the Reports of the State Board of Health, that at least one-half of the annual deaths in Massachusetts may be referred to three groups of causes; namely, consumption, typhoid and contagion. "An examination of the deaths from consumption in Massachusetts, during ten years (45,000 cases) shows that its distribution in the various towns is very unequal, in some of them the mortality from this disease being two and even three times the number found in others of equal size, and equally stationary population, representing all ages. Dr. Bowditch has clearly shown that among the prominent causes of consumption is exposure to soil moisture." (First Report, p. 46.)

As to the second group, we are told by Dr. Derby: "There can be no doubt that typhoid in Massachusetts is a disease of scattered communities rather than of crowded towns, of rural rather than of urban districts. In spite of the smaller mortality from all causes, typhoid is more destructive in the farming towns, than in the manufacturing towns and the large cities." (Second Report, p. 118.)

The results of all investigation seem to point to the decomposition of vegetable substances as a chief cause of typhoid fever in this Commonwealth. "Whether the vehicle be drinking-water made foul by human excrement, sink-drains or soiled clothing, or air made foul in enclosed places by drains, decaying vegetables or fish or old timber, or in open places by pigsties, drained ponds or reservoirs, stagnant water, accumulations of filth of every sort, the one thing present in all these circumstances is decomposition." (Second Report, p. 178.)

It seems to be equally clear that even contagions and epidemics usually select for their victims those whose systems are debilitated and so predisposed to disease, by want

of pure air and pure water as well as nourishing and sufficient food. That there is some good reason why three times as many persons die of consumption in one town as in another of similar population, and why typhoids prevail more in the country than in the city, we must all admit, and it is surely far more rational to look closely at home to ascertain whether our families are drinking diluted sink-water or breathing malaria, than to resent as an insult the suggestion that our diseases are the result of our own carelessness, as the natural man seems generally ready to do.

It has been truly said, that no man is so poor that he need have his pig-trough at the front door, and if we cannot single-handed drain a town, we can at least keep decent our homesteads.

We see that the well are made sick, and the sick are made worse for want of the two elements which a good God has given us absolutely without measure,—pure air and pure water. From toothaches to typhoids, from the neuralgias and rheumatisms that keep us in torment and will not even let us escape by death, to the fevers and cholera, which strike us down almost without warning, and even from consumption, slow but sure, we suffer in great measure, because we breathe bad air and drink bad water. We see too, that often, if not usually, the air is poisoned by emanations from stagnant water, either that which is naturally in the soil or in pools and holes about us, or that which we have rendered corrupt by the ordinary and careless arrangement of buildings for our families and our domestic animals.

The water of our springs and wells is corrupted by drainage from cesspools and sinks, so that we ourselves often systematically poison both the air we breathe and the water we drink.

The chief object of this paper is to show to people living in the country, how practically to render their homes more healthful, by draining off the natural surplus-water from their building-sites and surroundings, and by carrying away and rendering harmless and even useful the outflows of sinks, and of drains from chambers and water-closets.

The subject has not indeed in all respects a pleasant flavor,

but physicians and boards of health cannot well treat all diseases or their causes with rose-water alone.

Drainage of Building-Sites.

Many of our villages are upon ground which is naturally wet, either because it is flat and low or because it is on a hill-side, so that the rainfall is a long time in soaking through the soil to its outlet in some pond or stream. We have about forty-two inches of rain in a year, and this immense quantity must go off either by running away on the surface, by evaporation, or by percolating slowly through the soil.

We have therefore, ponds or small pools of water, swamps large and small, and much land hard and firm yet filled nearly to the surface with stagnant water. Land in which water wi l be found at a depth of two feet in any part of the growing season needs draining for agriculture. Land in which water is found at any season within four feet of the surface needs draining for health.

The principles and processes applied to the drainage of building-sites and their surroundings, are the same which are applied to ordinary farm drainage. The object is, at the least cost, to relieve the soil of surplus-water, or water that is not held by attraction, or in plainer terms, water that will run out of the soil. Ordinary soil, thoroughly dried, will receive about half its bulk of water before any drains off, so that three and a half feet of such soil may hold by attraction half the rainfall of a year.

We are here dealing only with clear water, to be conveyed in pipes that may take in or let out water at every foot, and such drainage is entirely distinct from the drainage of sinks and the like, which requires pipes much larger and smoother and also close-jointed and far more expensive, as we shall show under another head. And it should be said that this paper does not in any way relate to the sewerage of towns or cities, a department which belongs to skilled engineers, but is meant only to contain some hints to dwellers in rural homes.

As our space is limited, we must ask the reader to be content on many points, with simple rules and directions without discussion of reasons. If more than this is desired he

will find the subject fully elaborated in a book on "Farm Drainage" by the writer of this paper.

To drain a tract large or small, one acre or ten thousand acres, find an outlet low enough to give the necessary fall. One foot in one hundred is sufficient, and we have drains working well that have but a quarter of that fall. If the fall is slight, the greater care will be necessary in laying out the work and in performing it.

Common drain-tiles are recommended, rather than stones or wood, and the directions given are specially adapted to the use of tiles. They can be purchased in Boston and Albany, and many other places, at a cost of two cents each for two-inch, four cents each for three-inch, and six cents each for four-inch; and these are the only sizes necessary. They are usually about twelve inches long. If the four-inch are not large enough, two or more lines of them abreast may be laid. We have laid miles of drains and never used a conduit larger than a single four-inch pipe. Tile-drains are cheaper and more durable than stone,—cheaper because the excavation for them is much less, because they are more easily transported and laid in place, and because there remains no surplus earth to be removed; more durable, because they keep out sand and moles and frogs and other creeping things, which always destroy stone-drains, and tiles burned like hard bricks will last forever. If tiles cannot be procured, stones or bricks or wood may answer the purpose.

The work should be all laid out before breaking ground, and in general a day's service of a competent engineer to lay out the work and fix the grades, will be worth far more than it costs. Usually a single main drain should run through the lowest part of the tract, and it is not important that the main should be straight. Having laid out the main, lay side-drains running into it, having in view two principles: first, to run each drain up and down the slope of the land rather than across; and second, to have them parallel to each other. Like most principles, we shall be compelled often to compromise them. The depth should be four feet or more, and the distance apart, with this depth, may be from thirty to fifty feet. In any soil, except a close clay, fifty feet apart will be a safe distance.

To open them, begin at the outlet, so that the water may run off as the work proceeds, and with a common spade, and a pick if necessary, cut a trench by a line, eighteen inches wide at the surface, narrowing to four inches, or the width of a laborer's boot, at the bottom. The laborers will insist that they cannot work in so narrow a trench, and probably convince their employer, who of course has a right to follow their advice and waste his money if he pleases. To finish the bottom, a spade four inches wide is needed, and may be made by getting a blacksmith to cut down a common long-handled spade to that width, no wider at the heel than the point. This is the only peculiar implement necessary, all the assortment of "draining tools" being only valuable to sell. Having opened all the drains, keeping the main low enough to let off the water, we begin to lay the tiles at the upper end. If there is much fall and there is danger that the main or the lower end of it may cave in, it may be only partially excavated at first, just enough so that the water may run off from above.

Lay the first tile, usually of two-inch size, with a brick or flat stone over the upper end to close it entirely, and the next end to end with it, and so on to the main, keeping always an inclination, however slight, for if any depression is made, the silt will lodge in it and obstruct the work.

Here let this idea be fully impressed. In this system of drainage, no water is to be anywhere admitted except by percolation through the soil. There is to be no opening to the surface, or into any ditch, or to receive sink-water, or anything but clear water creeping underground.

But how does the water get in? Chiefly at the joints, which are as close as two rough bricks laid end to end would be. Nothing short of cementing the joints can keep the water out. The great difficulty is to keep out silt or fine sand.

Having laid two or three tiles on the bare earth, if hard, and on laths or other thin wood, if soft, cover each joint half or more round the tiles with a piece of tarred paper as large as a common letter-envelope, and holding the whole firmly, place soil or gravel over it and on both sides of the tiles, pressing it enough to keep them in place. However tempted to do so, put no stones nor straw nor shavings into the drain.

Cover and fill up with anything at hand, except soft clay or fine sand, which should not be placed in contact with the tiles. Most of the tiles used in Massachusetts are sole tiles, having a flat bottom and egg-shaped orifice, the small end of the egg downward. Round tiles have the advantage that they may be turned so as to get a better joint, but they require more care in laying, unless collars are used, and this adds fifty per cent. to the cost.

When we approach the junction of the minor drain with the main, a curve should be made, so as not to bring in the side-stream at right angles. Branch tiles may be found made for the purpose of junction, and these are much better than any home contrivances.

The capacity of pipes with round bores is nearly in proportion to the squares of their diameter. The square of two is four, and the square of four is sixteen, so that a four-inch pipe theoretically carries four times as much as a two-inch pipe, and actually carries more, the friction being less in proportion in large pipes. Again, water running down hill in a smooth pipe gains by accelerated velocity as any falling body does, and the stream grows smaller as it flows swifter, and so requires less space to carry it. If, however, a pipe be running full this acceleration is retarded, because the stream cannot lessen its bulk without leaving a vacuum. The admission of side-streams fills this vacuum, and thus allows the main stream to run faster.

With considerable fall, the main pipe may in fact be much smaller than would seem possible without reference to these principles. In one case in England it was found by actual experiment, that the addition of eight junctions, each of three inches diameter, into a main line of pipe of only four inches diameter, so increased the velocity of the stream that there was no increase of its sectional area. Even if the fall be slight, the pressure of water above, as soon as the pipe is full, vastly increases the velocity of the stream, so that it is rarely necessary to use pipes larger than three or four inches.

Having thus connected the drains in one system with only one outlet, this should be so secured by a wire grating that no frog or other creeping thing can explore it, and it should be built up solid with stone, so as to be permanent, and

should have a clear fall of a few inches upon a flat stone that it may not be obstructed by back-water and mud.

We have been thus precise in our directions how to drain a field or building lot because the same rules are applicable to the drainage of buildings.

How to Drain Cellars.

Did the reader ever when a child see the cellar afloat at some old home in the country? You creep part way down the cellar stairs with only the light of a single tallow-candle, and behold by its dim glimmer an expanse of dark water, boundless as the sea. On its surface in dire confusion float barrels and boxes, butter-firkins and washtubs, boards, planks, hoops and staves without number, interspersed with apples, turnips and cabbages, while half-drowned rats and mice scrambling up the stairway for dear life drive you affrighted back to the kitchen.

In a large proportion of the houses in some old villages in Massachusetts there is no provision whatever for any drainage of the cellar, and in thousands of houses the water as often as once in three or four years covers the cellar bottom, sometimes to the depth of two or three feet, and remains several weeks, gradually settling away as the general water-table of the town is drawn down by the subsidence of the freshet. In sandy plains the water lies usually nearly level, with a slight inclination toward some stream or pond or swamp, into which it slowly percolates through the ground. The water will, in such cases, be found at about the same level in all the wells and cellars. It rises into them as the ground is filled precisely as it rises in a well.

In soils with a bottom of clay or hard-pan, slowly pervious to water, it will often pond in the cellar when far from the surface in wells near by. The great spring-rains, with melting snow, have not time to soak down through the close soil, and the water seeks the nearest outlet from the overcharged soil, and finds it in the cellar, the bottom of which is too compact to allow its escape as fast as it enters.

Now consider the condition of one of these old farm-house cellars that has been in use fifty years or more. In it have

been stored all the potatoes, turnips, cabbages, onions and other vegetables for family use. The milk and cream, the pork and beef and cider and vinegar have all met with various accidents, and from time to time have had their juices in various stages of decay absorbed by the soil of the cellar bottom. The cats, so neat and peculiar in their habits, have slept there to fight the rats and mice, who have had their little homes behind the walls for a half century, and the sink-spouts have for the same term poured into the soil close by, their fragrant fluids. The water rushes upward and sideway into the cellar, forming with the savory ingredients at which we have delicately hinted, a sort of broth, quite thin and watery at first, but growing thicker as the water slowly subsides and leaves its grosser parts pervading the surface of the earth, walls and partitions, and the floors above fully saturated. All this time the air rushes in at the openings of the cellar, and presses constantly upward, often lifting the carpets from the floors, and is breathed day and night by all who dwell in the house. Does it require learned doctors or boards of health to inform any rational person that these conditions are unfavorable to health?

The most common method of draining a cellar of a New England country house is to construct a small stone culvert running from the lowest corner of the cellar to some low place a few rods distant, and digging little trenches across the cellar bottom in various directions leading to this outlet.

This is expensive and very imperfect, though better than nothing, as the water cannot rise so long as the drain remains open. Such a drain, having a flat bottom, and admitting floating particles of wood or vegetables, readily clogs, and it only removes water which is above the surface, leaving the cellar bottom muddy like a highway in spring-time, and requiring planks and boards to render the path tolerable. Small animals pass through such drains at pleasure, and in one instance we knew of a muskrat being caught foraging in a cellar which he had thus entered.

The cheapest and the best mode of draining a house-cellar, in most cases, is that adopted by the writer on his own premises in two instances. It is in fact a mere application of the ordinary principles of field-drainage already illustrated.

The writer purchased a farm in Concord, on which was a house which had been built about seventy-five years. It had no drain whatever, and it seemed to be generally agreed that once in two or three years water had always stood in the cellar, sometimes two feet deep. The occupants had been intelligent, wealthy farmers,—two or more generations of the same family,—who seemed to understand everything but drainage. Having taken levels, it appeared that a low tract on the opposite side of the highway gave sufficient fall for our purpose. A trench was opened from that point across the highway to the nearest corner of the cellar. We tunnelled under both walls and under the roots of very large elm and ash trees, and under the cellar-wall, going about four feet deep except near the house, where we went nine feet deep. The subsoil all the way was sand, very easily moved. In the cellar the drain was continued around the big chimney in the middle, to the farthest corner, about one foot below the surface. In the cellar were laid common two-inch drain-tiles, to the corner where the drain goes out under the wall. There three-inch tiles were used across the street about one hundred and seventy-five feet, then, as the soil was springy, four-inch tiles were used fifty-eight feet more to the outlet. The joints were covered with tarred paper, exactly as in field-drainage, and the soil was returned and levelled, the outlet was secured by a little wall of stone, and a copper netting was put over the last tile, and the work was done.

Let it be understood distinctly that the drain is covered all the way. There is no opening in it except the grated outlet. There is no place where a mouse or even a fly can enter. The air cannot draw through it except as it passes up through a foot of earth. It was laid in November, 1867, and in the same season a furnace was put in, with its ash-box level with the cellar bottom. The tiles for the two hundred and thirty-three feet cost $10.86, and the labor $10.50; in all, $21.36. This was the whole cost of what appeared to be a great work; except the small tiles and labor in the cellar, not more than would make the whole cost $25. The result is that there has never since been a drop of water visible in the cellar, although the spring of 1870 was one of the wettest seasons known, and many cellars in Concord were flooded.

In May, 1868, by careful measurement, the water in a well within twelve feet of this cellar was two feet above the tiles in the cellar bottom, the four-inch pipe running two-thirds full at the outlet, yet the small pipes in the cellar were sufficient to keep down the water, which in old times would have covered the cellar bottom a foot deep.

A cellar at Exeter, N. H., drained in precisely the same way twenty-two years ago, has been perfectly dry ever since, without any attention whatever being given to the drain, which will probably be as lasting as the house itself.

Often buildings are place on a slope or hillside, having a subsoil not readily permeable by water. In its natural state the surface-soil may be open enough to be sufficiently dry for cultivation, as the water from rains in the growing season may pass downward out of the way, and run off upon the underlying stratum. But a cellar is sunk four, or five feet and stoned up, and forms a reservoir which catches the water flowing in the soil, and holds it for weeks or months until it passes slowly downward. In such a case it is often practicable to catch the water before it enters the cellar, and so avoid all dampness, by running drains on one or more sides of the building outside the walls.

In several instances the writer has suggested this idea to occupants of valuable houses, in the cellars of which the water unaccountably collected, when all the soil around seemed dry, and an easy remedy was afforded. In the fall of 1870, Mr. Marsh, the superintendent of the state almshouse at Tewksbury, called to see if any way could be devised to relieve the new structure there of a very serious invasion of water. The building is of brick, one hundred and twenty-five feet long and three or four stories high, and a large dining-hall runs through the basement, the floor of which, on one side, is some two feet below the ground. It was found that the floor of the dining-hall was flooded with water in the wet season, and it had been suggested to take out the floor and cover the soil under it with a heavy coat of cement, and cement the side walls, and so exclude the water. Mr. Marsh hoped to find a cheaper remedy.

Having a sort of contingent interest in the state almshouse, we went over and examined the matter. The building

stands upon elevated ground, but upon a broad slope toward the north. The land rising from it toward the south is apparently dry and is under good cultivation. It was at once seen to be one of those instances where the water from rain passes through the surface-soil and flows along the closer subsoil.

We advised the superintendent not to disturb his floor, but to open a narrow trench as near to the building as was safe, running parallel with it and two feet below the lowest foundation-stone, with a slight fall toward the west, where there was sufficient descent, and to lay in the trench a single line of three or four-inch drain-tiles, and to fill the trench with gravel or coarse sand.

The drain being designed for a catch-water, it would not be prudent to fill it with clay or compact soil, because in a great flush of water it might pass across the drain above the tiles, especially as the drain must be quite deep. We heard no more of Tewksbury almshouse till this paper was commenced, when we wrote to Mr. Marsh, inquiring about the matter, and he called and made report. He, with only common laborers, opened the trench six feet from the building, and two feet below the foundation, making it from five to eight feet below the surface, and 225 feet long and laid it with four-inch tiles and covered them as directed. There has been a great flow of water in all wet seasons from the outlet, and the floor of the basement has been perfectly dry ever since. An addition 125 feet long has been made on the west side, and the drain answers for the whole extent of the building, 250 feet. The tiles cost four and a half cents each, or about $10 in all, and all the other cost was the labor of opening and filling the trench.

The idea of cementing the floor and inside of the wall of a cellar or basement to exclude water is very common. The pressure of water is in proportion to its height or head, without reference to the extent of its surface. If then the water be heaped up behind a cellar-wall to the surface, we have a pressure equal to that of a mill-pond against its dam seven or eight feet high. No sane man would think of tightening a dam of that height by plastering the down-stream side of it

with cement. We have seen one instance where a cellar was carefully and heavily cemented to exclude water, and the pressure of the water lifted the whole body of the cement from the bottom, leaving it in broken masses, like flagstones half on edge. It is certainly practicable to exclude water from a cellar by a heavy wall laid in cement, and a heavy cemented floor of brick or stone, but the process is very expensive, and leaves the adjacent soil saturated with water in wet times.

What makes the Water Bad?

Hundreds of people in the country are asking this question constantly. If we abruptly reply, "Because your sink-drains and vaults empty into it," the truth would usually be spoken, but the seed would fall on stony ground. The very horror of drinking such pollution leads one to exclaim, "Is thy servant a dog," and to turn away in indignation. It seems an insult to be told that we are guilty of such gross carelessness in a matter so vital. We must, therefore, approach the question more circumspectly. That there is a good reason why the water of a well which has been used for years suddenly becomes offensive to taste and smell, all must admit. There must also be a reason why it is sometimes much more offensive than at other times, as is usually the fact.

There are certain principles that must be kept in mind in such investigations. Common soil is one of the best deodorizers. It will absorb and retain a great amount of corrupt and decomposing matter, depending much on the character of the soil. It may, therefore, be a long time before the deposits in the soil, however foul, will extend even twenty or thirty feet. Bearing in mind, however, that the clouds give us three and a half feet in depth of water annually on every foot of our land; that, in addition to this, all that falls on our buildings is poured down upon the soil near them, and that all that is used in kitchens and wash-rooms is added thereto, and we see that there is a flood of water which goes somewhere. The water in the well stands ten to thirty feet below the surface. We know that drains in our fields, four feet deep and fifty feet apart, carry off all the water of the heaviest

rain in forty-eight hours, merely because the water, by gravitation seeks the lowest outlet. It is a general rule in drainage that drains draw water from distances in proportion to their depth. A well therefore operates as a very deep drain. No water will be found near it, without digging to the level of the water in the well. The well drains all the soil in its neighborhood. Whatever fluid permeates the soil tends towards the well, and the problem is whether the soil through which it passes from vaults and sinks and stables has capacity to purify it on the way, so that it is fit for daily family use.

The subsoil is usually more compact than the surface-soil. Clay frequently underlies sand at a depth of a few feet. The subsoil has generally an inclination or dip, and the water tends down the slope upon the more compact subsoil, just as it would run on a compact surface, only slower. Careful observation will teach us the direction of the underground water, and it is always safest to dig our well on the up-stream side of the buildings, so that the tendency of the natural drainage from them may be away from the well. This is especially necessary in sandy soils, in which the wells are shallow, and are usually dug but little into the hard subsoil, which stops the downward passage of the water so that we come to water when we reach the stratum which stops it.

And now what practically shall we do to keep apart our vaults and sinks and barn-cellars from the wells? A shallow well in sandy soil is far better laid with brick in cement, than with stone in the ordinary way. We may thus exclude all water except what passes in at the bottom, compelling all the water to filter through the soil to the depth of the bottom of the well. Well-water is usually worst when lowest. When the water stands as high in the well as in the vaults and cess-pools near it there is no drainage from one to the other. Besides, when a given quantity of filth is dissolved in a great deal of water we do not so readily taste or smell it. When the water is low in the well and then is rapidly pumped out, all the fluids in the neighborhood rush to supply its place. If, however, the intervening soil is dry enough to absorb the foul water the filth may not reach the well till rain enough falls to

carry it along. We should expect bad water from such causes in or just after a drought.

As to common privy-vaults, lay them with brick and cement carefully, water-tight, of capacity say of forty to eighty cubic feet for a common country house. Fill one-third full of dry soil of any kind except sand, and add more from time to time, clearing it out two or three times a year for use in the garden or field. If no water is drained or poured into it, the contents will be dry and inoffensive enough to be shovelled into a cart at any time. This will be an improvement on the common arrangement. It is throwing slops into such a vault that makes it offensive, and this must never be allowed. A bed of muck or soil hollowed in the middle upon which, through a spout or otherwise, the chamber-slops can be poured, if occasionally changed, will absorb their odor and add value to the compost-heap. Every house, however, should, have upon the level of its chamber-floor conveniences of a better kind. As such arrangements are not within the scope of our subject they will not be here discussed.

Sink-Drains.

A great many instances have come to our notice of wells polluted by sink-water. In one case, in midwinter, a neighbor informed us that his well had become too bad to use. It was forty feet from his sink-spout, which emptied into the ground. The soil was loose sand on clay, and the well about ten feet deep. He could not believe that the sink-water reached the well, but as he could not use the water, and wells are easily dug there, he sank another on the other side of his house and found good water. The following spring he found the sink-water had stained the soil all the way straight to his first well. In this case the buildings had been occupied but two or three years.

It is hoped that the reader has supped full of horrors long enough to feel an interest in the practical means of getting rid of sink-water. There is no fluid so hard to carry away. The soap and grease are deposited on the sides of the pipe, and it may be said to be a mere question of time, depending on the size of the pipe, how soon it will fill up. This is why

the drainage of clear water should be kept distinct from that of cesspools and sinks. Clear water will flow in half-inch pipes, while four to six inches is small enough for sinks and cesspools, and the joints of the latter must be tight, while common drain-tiles are open.

We will describe a method in successful use for five years with no obstruction whatever, with a fall only about one in a hundred. It is cheap, efficient and durable, and requires little skill in construction.

At the sink is a common bell-trap. A lead-pipe of one and a half or two inch bore runs down and out through the cellar or ground into a reservoir, which may be a strong oil-cask of fifty to a hundred gallons, or of very well cemented hard brick. It should be a foot or more below the surface, so that, properly covered in winter, it will not freeze. The lead-pipe should discharge under water, and so we have a second trap that prevents any air passing up the pipe. The outlet-pipe, starting about one-third up from the bottom, may be of lead, one-half to two-inch bore, and should run upward and out of the reservoir at about a third from the top and into a large pipe of stone or iron. Thus the water enters the lead-pipe about midway from top to bottom, leaving the greasy particles floating on top and the heavy particles at the bottom, so that what runs off is comparatively clear. It still carries off a great deal of soap, and will deposit it for a long distance. At our own house a five-inch stone-pipe runs one hundred feet to the barn-cellar, where it is again trapped in a cask, and carried thirty feet further to the manure-heap under the stable, far enough and low enough to keep it out of the well. The large pipes fit into each other, and are made tight with cement. They should be carefully laid, keeping always a slope, and a swab should be used to rub down the cement inside as each joint is laid. Three or four times a year the cover of the reservoir should be removed and everything cleared out.

The final deposit or cesspool into which sinks and water-closets are discharged should be placed, if possible, below the level of the water in the wells at their lowest, and always on the down-stream side of the well, as the water is supposed to

flow in the ground. A large vault, cemented or not, as seems necessary, may be supplied with a quantity of dry soil or peat, and the moisture may be thus absorbed, or a trap may be there arranged which shall separate the fluid, which may be pumped out and applied to the soil; or the moisture may be absorbed by the earth, if the conditions are such as to render it safe.

A judicious application of the principles given will enable a man of ordinary common-sense to take the precautions essential to health, so far as relates to drainage.

INFANT MORTALITY.

By EDWARD JARVIS, M. D.

INFANT MORTALITY.

The perfect child comes to the world with all its organs in complete condition,—the stomach to digest its food, the heart to circulate the blood, the lungs to purify it, the nutrient arteries to convert it into flesh, the skin for protection, the bones and muscles for motion, and the brain to preside over all.

"Death in childhood is an unnatural event, inasmuch as the regular series of development of the human structure, from the germ-cell to the perfect man in his prime and in his last declining stage of existence, is interrupted."

"But life, at all ages, depends upon so many conditions, and is exposed to so many risks, that out of given numbers of living some die at every age, and we can only take for a practical standard the lowest authenticated rates of mortality."*

This is the physiological view of the early condition of man.

There is no gift to humanity so great, so valuable, none that offers so rich a source of happiness and comfort, as a child to a parent. There is nothing of which so much may be made. There is no such treasure offered; no such responsibility placed upon a family.

The child is the promise of all the hereafter. The whole future of the world is wrapped in him. Unless he fulfil this promise and grow to manhood, the family ceases, the state perishes, the human race comes to an end. The family have the intensest interest of affection in his preservation, and all the pride and power of the nation rests upon his life.

But as soon as the child appears among us, with all the promise of life, it is beset with manifold perils, that assail its vitality and tend to destroy it. These influences of evil appear on every side, to which it has but little power of resistance. Although perfectly organized and endowed with all the means of carrying on the processes of life, the child is fragile, it has a small amount of vital force and requires

* Reg. Gen. England, Supplement to 25th Rep. p. ix.

favorable conditions and incessant care to protect it from the dangers that may threaten it.

Death then begins at once to assail these hopes of man, and in the first week, the first month, the first year, and onward, children perish in large numbers.

Beaugrand says :—

"For a long time hygeists have been occupied with the enormous mortality of infants in their first year. A great number of works have been published on this important question. Statisticians have been called to aid in the explanation of the complex condition of this social problem."

Everywhere in the world, and in all ages from the beginning, there is and has been the great cry of disappointment and sorrow at this great loss. There is and has been a great diversity in the mortality of children in various places. These differences are connected with varying conditions and circumstances. The seasons, local and endemic influences, and more than all, the means and manners of life in the family seem to be prominent as friends or foes, to aid or impair the infant constitution, in its struggle against the adverse influences that threaten it.

To the wise and the faithful are accorded the best results of their endeavors, to save their infants from destruction. But no community is free from this danger or loss. The records of all nations show a large proportion of the children that perish, on the way, from birth to maturity.

Massachusetts is one of the most favored States in the world for the intelligence, at least of its native population, and for their thrift and wisdom in management. In this Commonwealth, during the fifteen years ending 1870, there were 514,233 children born; and 71,526, or 13.91 per cent. of these died in their first year, and 131,784, or 25.52 per cent. before they had completed their fifth year. This includes the record of the foreigners, whose infant mortality was in a larger ratio, as well as that of the native families whose infant mortality was at a lower rate, than this average.

The following table shows the experience of most civilized nations in this respect :—

* Annales de l'Hygiene, 2d series, xxiv. 218.

Showing the Births and Deaths under one and under five, and the ratio of each to Births.

COUNTRY.	Period.	Births.	Deaths.		Ratio of Deaths to Births.	
			Under One.	Under Five.	Under One.	Under Five.
Massachusetts,[1]	1856–1870,	514,233	71,526	131,784	13.91	25.62
Michigan,[1]	1868–1870,	78,786	–	11,072	–	14.05
England,[1]	1851–1860,	6,471,650	996,630	1,706,583	15.40	26.37
Scotland,[1]	1855–1868,	1,331,250	180,363	353,906	13.55	26.58
Sweden,[2]	1856–1860,	404,829	90,135	159,993	14.34	25.46
Norway,[3]	1856–1868,	677,967	72,651	127,635	10.71	18.82
Prussia,[4]	1852–54,	2,292,150	411,398	678,875	17.94	29.61
Austria,[5]	1860–61–65,	3,076,811	775,082	1,175,598	25.19	38.19
Bavaria,[6]	1857–62,	823,468	280,353	335,687	34.04	40.64
Netherlands,[7]	1850–59,	1,075,979	260,112	379,153	24.17	35.24
France,[8]	1857–62,	5,739,275	964,434	1,560,480	16.80	27.18
Italy,[9]	1868,	900,416	204,300	366,200	23.80	40.67
Spain,[10]	1858–62–65–68,	5,334,958	993,115	2,052,212	18.61	38.16

[1] Annual Reports.
[2] Officiela Statistik Helso och. Sjukvarden.
[3] Officiela Statistik.
[4] Preussische Statistische, 1862–3–4–9.
[5] Statistische Jahrbuch, Oesteriche.
[6] Statistik der Konig-Bayern.
[7] Statistisch Jaarboek, Nederland.
[8] Mouvement de la Population.
[9] Statistica de Regno d'Italia, 1868.
[10] Annuario Estadistico de Espana 1866–67.

Another method of comparison is the proportion of deaths to the living at the same age. This is stated in the English and Scotch reports, and may be calculated for others.

A less reliable ground of comparison, but none the less certain as evidence of early mortality, is the proportion of deaths that fall on any age to the total number of all ages.

The following table shows the proportion of the total deaths that fell on those under one and under five years :—

COUNTRY.	RATIO PER CENT. OF ALL AGES. Under 1	Under 5	COUNTRY.	RATIO PER CENT. OF ALL AGES. Under 1	Under 5
Massachusetts,[1] .	19.43	36.61	Norway,[4] . .	18.82	33.33
Kentucky,[1] . .	21.87	41.61	Prussia,[5] . .	21.25	47.52
So. Carolina,[1] .	23.31	45.59	Austria,[6] . .	30.39	49.96
Michigan,[1] . .	25.93	33.21	Holland,[7] . .	31.94	46.58
England,[1] . .	21.24	40.53	France,[8] . .	20.92	32.71
Scotland,[1] . .	19.35	37.96	Italy,[9] . .	27.72	47.26
Russia,[2] . . .	–	52.60	Spain,[10] . .	18.61	38.46
Sweden,[3] . .	22.26	39.52			

[1] Annual Reports.
[2] Government Report.
[3] Officiela Statist. Helso.
[4] Officiela Statist.
[5] Preussische Statist.
[6] Statist. Jahrbuch.
[7] Statist. Jaarboek,
[8] Mouvement de la Population.
[9] Statistica del Regno.
[10] Annuario Estadistico de Espana 1866 67.

Here are manifestly very different proportions. This difference may be, in part, due to the difference of the composition of the living population.

In a State just settled by immigrants a very large proportion of the people are youths and middle-aged, and comparatively few children, and still fewer infants and old people, and of course, in their mortality, there would be a correspondingly large proportion in middle life, and small in infancy and old age. Soon they marry, and in a few years the young children and infants form a large and the aged a small proportion of the population. Consequently the reports of deaths in the same period, show a large proportion of infants, a smaller proportion of the middle-aged, and very small of the very old. Nevertheless, in old and fixed populations, these differences indicate something more than the difference of the proportions of the living.

Whatever may be the explanation of the difference of the proportion of infants to total mortality, still the irresistible fact remains that from nearly one-fifth to nearly a third of all the deaths fall upon infants under one; and from a third to a half upon children under five; and the still more decided and indicative fact that from a seventh to one-fourth of all that are born, fail to pass their first year, and twenty-five to forty per cent. perish before they have completed their fifth year.

Reasons.

The first question that arises is, whether it is a necessary condition of human life that so many should perish in the outset. Are these proportions of children endowed originally with such feeble constitutions, that they cannot endure the burden of earthly life beyond the period of one or five years? Are they endowed with only sufficient living force to run the vital machine for these brief periods?

There is no doubt that with many it is so, that some children are born with low and imperfect organizations, and with constitutions too weak to sustain the process of development, and therefore more or less must fall by the way. This explains a part of this great proportion of infant mortality.

Premature Birth.

The security of infant as well as of adult life, depends primarily on its constitutional force, or power of performing its organic functions with vigor and comfort, even amidst the causes of disturbance and disease.

The primordial constitution depends on prenatal conditions which belong to or may be controlled by the parent. Life proceeds from life, like forms like. The parents can give only such as they have in themselves. The feeble, the scrofulous, the intemperate, those who are themselves vitiated or impaired by heritage, by disease and exhaustion, or by sensual indulgence, have no fulness of power to impart to their children. The parents who in any way waste or vitiate their own vita force, or unwittingly suffer it to be vitiated or reduced, do or suffer this for their offspring that afterward proceed from them. Their constitution, whatever it may be, is an entailed estate that must pass, with all its worth and incumbrances, to the

heirs of their own bodies. The misfortunes and sufferings as well as the iniquities of the fathers and mothers are visited upon their children, possibly, even to the third and fourth generation.

The conception and the prenatal being of the child are thus entrusted to the parent, and it requires for its full development and preparation for outward life and exposure, all the mother's care and devotion. If she fail to regard her new condition, and recognize her new responsibility, and adapt her habits of action, costume and diet to the wants of the prospective child; if she, from influence of fashion, desire of concealment or other motive, refuse to allow the child opportunity of expansion, or if she expend her forces in excessive labor or exposure, or dissipation of gay or vulgar society, or if she suffer from privations of proper food, or indulge in unsuitable diet, and thus impair her digestion, or embarrass her nutrition, she diminishes her power of giving her child the full development that can only be secured by a healthy and well ordered life in the parent.

All these conditions and habits as they occur in the parent, have their natural effect on the constitution of the child, and diminish its power to bear the exposure of the world, and to resist the causes of disease.

The first and immediate danger from any irregularity of the mother is premature birth, which sends the child abroad before it has completed the prenatal development that nature intends for her perfect children. Those who are thus born before their time are generally, almost universally, feeble, and imperfectly prepared for outward life.

In England, during the six years, 1858 to 1863, inclusive, among 626,340 children that died in their first year, 45,814 were prematurely born,* and had incomplete development, and therefore, were imperfectly prepared for the contact with the outward world. These constituted 7.31 per cent. of all the deaths of children, under one year old. In the ten years, 1861 to 1870, the deaths of 85,118 children, or 1.75 per cent. of the whole, are ascribed to this cause alone.†

* Supplement to the Reg.-Gen. 25th Report p. vi.

† Reg.-Gen. 24th to 33d Reports.

There is no record to show how many of the children were prematurely born in this period, but it is not to be supposed that they made any approach to the proportion. The premature children have a much harder struggle to live, than those that are born at full time, and a much larger proportion succumb before the trials that they encounter.

"At the Maternity Hospital in Paris, in 1869, there were 1,320 births at full time and 641 premature, 1,961 in all. 127 or 9.5 per cent. of these born at full time, and 332, or 51.8 per cent. of those prematurely born, died early. The proportion of mortality in the last was almost six times as great as in the class more completely developed and prepared for the chances and exposures of life." *

Difference of Constitutional Force.

In the question of mortality or liability to death, there is ever to be held in mind, both the power of the disease or the destructive agent, and the constitutional power of resistance.

A child inheriting a weak constitution or prematurely born, with constitution incompletely developed, or with constitutional force reduced by imperfect nutrition, exposure to cold or extreme heat, or by neglect, must yield before a smaller force of morbific agency than one born at full time, with constitutional powers completely developed and sustained by proper and successful care.

Healthy Districts.

Philosophical vital statisticians make several classes of districts, divided according to their sanitary conditions and vital results. Those that have the lowest rate of mortality, show at least the natural liability or capability of living, belonging to the human constitution in the best condition and under the most favorable circumstances. In table, on page 196, the lowest rates of mortality, as compared with the births, were 10.71 per cent. in the first year, and 18.82 per cent. under five, in Norway.

In Massachusetts, the mortality, under one, was 13.91 per cent., and under five, 25.62 per cent.

In Sweden, these proportions were severally 14.34 and 25.46 per cent.

* Beaugrand, Ann. Hyg. xxiv, 2d series.

They were 15.40 and 26.37 per cent. in England, and in Prussia 17.94 and 29.61 per cent.

On the other extreme, the deaths were 25.19 per cent. under one and 38.19 per cent. under five in Austria, including Hungary. They were 24.17 and 35.24 per cent. in Holland, and 23.80 and 40.67 per cent. in Italy, and the highest rates were 34.04 and 40.64 per cent. in Bavaria.

Thus we see, that the infant mortality was more than twice as great in Italy and Holland, two and a half times as great in Austria, and almost three and a half times as great in Bavaria, as it was in Norway; and the proportion of deaths of children, under five, was twice as large in Spain, Italy, Austria and Bavaria as it was in that colder but more healthy country of the Norwegians.

Thus, as often as 1,000 infants died in Norway, 1,298 died in Massachusetts, 1,338 in Sweden, 1,438 in England, 1,738 in Spain, 2,222 in Italy, 2,257 in Holland, 2,352 in Austria, 3,178 in Bavaria, among the same numbers born in each country.

It is not to be supposed that it is the primary intention of nature that the little children should perish so much more frequently in Bavaria, than in Norway or Massachusetts. The Norwegian rates of mortality, 10.71 per cent. under one, and 18.82 per cent. under five, are the lowest for infants and children that are found in the record of any nation. This, however, includes the whole country of Norway,—all its districts, healthy and unhealthy, all its people, discreet and indiscreet, favorably and unfavorably situated.

If a selection of districts, and people, and families could be made, and the experience of only the best included, there would be found a much lower rate of early death than these figures present for the whole nation.

Yet taking these rates of 10.71 per cent. under one and 18.82 per cent. under five, and admitting that so much is unavoidable, certainly in any large community it is worth while to inquire whether the excess that is found elsewhere, or even a part of that in Norway, may not be due to causes that are, in greater or less degree, subject to human control, and whether if guided by the best intelligence and under the

best moral discipline in those that have the care of infancy and childhood, the death-rate in these periods may not be reduced everywhere to the Norwegian standard.

From their exceedingly delicate sensibility, infants are susceptible of injury from manifold causes, either in the omission of what is necessary in appropriate food, in pure air, in temperature, in protection from cold, in the many attentions that tender and judicious nursing may give to develop the constitution or to sustain it during the progress of growth.

These morbific influences are found in various degrees and proportion in all countries and among all people. No one stands alone anywhere, but each may have a prominence and do most of the deadly work on those feeble lives.

Care of Infancy.

The most difficult task undertaken by man is the creation and development of life. Gardeners watch their tender germinating seeds and shooting plants with unfailing attention. They regulate all the influences that can bear upon them. They provide in due measure appropriate soil, nutriment, moisture, air and warmth, knowing that from any neglect of these matters the health of the feeble plant must suffer, and life may fail.

Farmers watch the young of their animals with assiduous solicitude; they inquire into every circumstance and determine its probable effect on the new life; they give the tender beings every favorable influence, and defend them from all that may harm them,—cold, rain, and improper food.

No other form of life, whether in the animal or plant, is so tender and so susceptible of injury as that of a child; it is the most delicate of all creatures, and demands the most exact obedience to the conditions of its being and the appropriate supply of its wants. It bears no neglect without suffering, no injudicious interference without injury.

Deaths in Early Weeks and Months.

This extreme tenderness is in the inverse ratio of the age of the child. The largest ratio of death is in the first week

and the first month. It gradually diminishes from the beginning of the child's days.

In France, the record shows that of 1,000,000 children born,—

29,123	die in the	first week.	
22,128	"	"	second week.
22,236	"	"	sixteen following days.
73,487	die in the	first month.*	

In England, according to the Life-Table, of 1,000,000 that are born,—†

46,503	die	in the	first	month.
17,195	"	"	second	"
12,178	"	"	third	"
10,100	"	"	fourth	"
9,550	"	"	fifth	"
9,033	"	"	sixth	"
8,547	"	"	seventh	"
8,087	"	"	eighth	"
7,657	"	"	ninth	"
7,253	"	"	tenth	"
6,872	"	"	eleventh	"
6,518	"	"	twelfth	"
149,493	die in the first year.			

From these it appears that in France, one in 34 died in the first week, one in 44 in the second, and the same proportion in the next sixteen days, and one in 14 the first month.

In England, one in 21 died in the first month, one in 56 in the second, one in 77 in the third, and one in 131 in the twelfth.

With its exceedingly delicate susceptibilities, the infant demands every favorable condition of care, clothing, warmth,

* Reg. General England, Sup. to 25th Rep. p. vii., calculated from the French Reports.

† English Life-Table, p. xxiii.

air, food and circumstances. It wilts under every privation of any of these means of life, and sinks under any adverse influence, from whatever cause.

Diseases of Infancy and Childhood.

The diseases that destroy life in infancy and childhood are found in all countries and climates, yet in very different proportions. The following tables show the ratios of deaths from each cause or class of causes, of children in the United States, Massachusetts and England :—

Showing the Proportion of Deaths from each Cause, or Class of Causes, to all Deaths under five, in the United States and Massachusetts.

CAUSES.	MASSACHUSETTS.* Both Sexes— 1870.	UNITED STATES.† Males— 1859-60.
ALL CAUSES,	10,000	–
Disease of Brain,	138	214
Bronchitis,	102	70
Cephalitis,	355	474
Cholera Infantum,	1,740	327
Consumption,	323	255
Convulsions,	480	523
Croup,	414	942
Debility,	195	52
Diarrhœa,	257	412
Diphtheria,	157	52
Dysentery,	288	489
Enteritis,	94	202
Typhus Fever,	134	164
Hydrocephalus,	457	207
Canker,	133	–
Measles,	203	184
Infantile,	476	427
Pneumonia,	685	739
Premature Births,	252	–
Scarlet Fever,	714	1,075
Tabes Mesenterica,	274	44
Teething,	292	322
Whooping-cough,	327	447
Burns,	55	–
Casualty,	25	450
Lung Diseases,	29	113
Scrofula,	55	83

* Annual Report. † Census, 1860. Mortality Vol.

*Showing the Proportion of Deaths from each Cause, or Class of Causes, under one year in England.**

CAUSES.	Males.	Females.
ALL CAUSES,	1,000,000	1,000,000
Disease of Brain,	223,209	208,015
Disease of Lungs,	146,561	137,218
Cholera, Diarrhœa, Dysentery,	90,218	93,619
Other zymotic diseases,	39,431	43,118
Whooping-cough,	33,174	45,068
Hydrocephalus,	27,794	24,587
Disease Stomach and Liver,	23,490	19,810
Scrofula, Tabes Mesenterica,	23,373	23,865
Measles,	13,669	14,446
Phthisis,	12,548	13,975
Scarlet Fever,	11,252	11,299
Violence,	10,488	12,109
Small-pox,	9,773	11,201
Typhus Fever,	5,762	6,010
Heart Disease and Dropsy,	4,151	4,481
Disease of Skin,	2,829	3,225
Diphtheria,	1,931	1,798
Disease of Kidneys,	376	272
Disease of Joints,	316	446
Cancer,	154	209
Disease of Generative Organs,	79	59
Other Causes,	318,768	324,905

Thus it is seen that diseases of the digestive organs caused more than one-quarter of the deaths, under five, in Massachusetts, and about one-ninth, in England. Diseases of the brain and nervous system, including dropsy and convulsions, destroyed about one-seventh in Massachusetts, and one-fourth in England. Disturbances connected with the lungs and respiratory organs, including croup and whooping-cough, caused nearly one-fifth of the deaths of children in both countries.

These are the leading causes of death in infancy and childhood, in all nations, but differing in their proportions.

Both in Massachusetts and in England the reports include a considerable number of deaths, mostly in infancy, under the causes termed "Debility," "Atrophy and Debility," "Inanition," "Premature Birth," all resting upon imperfections of

* Calculated from Table in Supplement to Reg. Gen., 25th Rep., p. 2.

constitutional development or force, and inability to digest food and obtain from it sufficient nutriment for the body.

Food and Nutrition.

The prominent wants of the infant are food, warmth and air.

The first is provided by nature in the mother's milk, which is exactly adapted to the feeble and tender digestive organs of the child, and changes in its character with the necessities and capacities of the new-born consumer.

No other aliment can take the place of the human milk. The milk of other animals,—cows, goats, etc., are not so well adapted to the powers and wants of infants. Their stomachs find great difficulty in digesting it, and their assimilative organs often are unable to extract from it sufficient aliment to supply the wants of the textures.

The nurse-bottle, which is used, too frequently for the child's good, from seeming or actual necessity, is filled sometimes with contents less acceptable and more injurious to the infant's stomach—gruel, chicken-broth, pap of manifold kinds. Beaugrand, in his article on the early death of the new-born, calls the nurse-bottle deadly, "*funeste*," and shows how the children that are fed by it sometimes die from inanition, as it is termed, from want of power to convert the food into flesh. Whether the child has nothing to eat, or has its stomach filled with food which it cannot digest, or of which the nutrient arteries cannot make flesh, it is all the same to the child; it is actually starved for want of nourishment in the textures, the place where it is needed.

Mother's Temporary Absence.

The infant not only needs the mother's milk, but wants it frequently. The fountain should never be long absent.

The nursing children of those mothers whose labor or business or pleasure require their protracted absence from home, suffer much from hunger and defective nutrition. Some pine away, and some at length sink into death. Among the poor there are some who are called from their homes, to work abroad during the day. They are with their babies and can nurse them only in the morning, before they go to their

work abroad, at noon when they return to their own dinner, and at night after their day's labor is finished. And some even are absent through the whole day. The infants are thus left to be fed at home by cow's milk, goat's milk, farinaceous food and other unnatural and unsuitable means.

This is common in England, where women work on the farms, often distant from their homes, and in the factories. Dr. Husband says :—

"In some of the agricultural districts of England we find a very high rate of infant mortality. The medical officers of health, after investigating the subject, found that the cause of the excess was the employment of female labor. The mothers are employed at out-of-door work, and their children are left in the hands of bad nurses, or children not much better.

"It is found that in certain families, child after child is born, which as regularly dies, and the neighbors know as well as may be, that the child terminates its existence, not through accidental death, but from carelessness and deprivation of food." *

Beaugrand says, that in the neighborhood of great manufacturing establishments, in France, the children of the female operatives perish in their early weeks or months of life from this cause. The mothers in their straitened circumstances, feel obliged to contribute as much as possible to the support of their families, by working in the mill. So they get back to the factory as soon as possible, after their confinement; consequently, the sickness and mortality of the infants of these mothers are increased. This was manifested in many industrial centres. In Manchester, England, the death-rate of these children of the operatives rose to 22 to 23 per cent., and in Mulhouse, a large manufacturing town of France, it rose as high as 30 even 38 per cent. This attracted the attention of Mr. Dolfus, the wealthy proprietor of one of the establishments, whose wisdom and success were only equalled by his thoughtful benevolence. He then ordered that every one of his female operatives, who should be confined, should remain at home and attend to her child, for six weeks, after it was born; but that her wages should be paid the same as if she were at work. This was the first of November, 1862. There were then 1,050 women employed in his factory; one hundred and eight of these were confined

* Social Science Transactions, 1854, page 506.

within the next year, and twenty-five of the children died. This was but two-thirds of the proportion of the previous year's mortality. In the next year, the mortality was still farther reduced.

Mr. Dolfus was so well satisfied with the result of his humane plan, that he proposed to other manufacturers, who employed married women, to adopt it as a permanent rule for their establishments.

Dr. Beaugrand adds, in his admirable article, in the Annales de l'Hygiene, 1866—"We proclaim these facts abroad, in trust that all establishments may follow the example of these manufacturers of Mulhouse, who have already ameliorated so greatly the condition of their working-women."

To meet this difficulty, establishments called *creches* have been opened in Paris, London, Manchester and other places, where mothers can deposit their little children, while they are at work away from their homes during the day. Here doubtless these infants are taken care of, as well as possible, in the circumstances. But they are deprived of their natural food, and have a lower chance of health and life, than if they were not separated from their mothers. Dr. Husband adds, "This is after all a very poor substitute for the care and attention of the mother, and a very inadequate provision for the comfort of the child, but no doubt it saves many an infant life." *

The necessities of infant nutrition are the same in all ranks of life, and the child suffers from the want of sufficient and appropriate food, at short intervals, in its early and feeble being. Whenever the mother is kept away, from whatever cause, whether by the necessities of earning bread for herself and her other children, or by the calls of society, or the simple power of ignorance or indifference, the child hungers and is weakened, and sometimes takes the steps that lead to death. The necessity of appropriate nutrition with the mother's milk, and at due times, admits of no relaxation, and cannot bear neglect without injury to the child, through the early months, even to a year or more.

The English and Irish reports include a considerable

* Social Science Transactions, 1864, page 509.

number that died for "want of breast-milk." Dr. Husband says this privation leads to debility, inanition, difficult teething and general impairment of health, and consequent inability to resist attacks of disease. And many a child, that was robust as long as it had the natural food, withered away when it was put upon an artificial diet, and finally sank under a mild attack of diarrhœa.

The French statistics show that in one part of France "when children are given to wet-nurses and have the human milk, though not the mother's, the mortality is 37.1 per cent. But in the class of children that are brought up by hand on cow's and goat's milk, or other food, through the nurse-bottle or the spoon, the mortality rises to 63.9 per cent." This difference is noticed in the neighborhood of Paris, to which many of the children are sent from the maternity and foundling hospitals of the city.

Effect of Food on Milk.

It is well known to farmers, especially to those who are milk-producers, that the milk is very materially affected by the food they give to their cows. If they eat onions, the milk has a taste of garlic. Turnips impart a peculiar and unpleasant flavor, and sometimes the cattle eat noxious herbs in the pastures, which are discovered only by the offensive state of the milk.

Distillery-Milk.

A few years ago, there was a great complaint of the milk in New York, which was supplied to the market from cows that were kept at the distilleries and fed upon the waste vegetable matter, the residuum of the process of distillation. The sanitary authorities caused the milk to be chemically examined, and they watched its effect upon the children and adults who drank it. The milk was found to be bad. It was different in elementary character from that produced by cows that were fed upon grass, hay or grain. It was not so well digested in the stomach, nor had it the nutritive power to create flesh and sustain strength. The children lost flesh or failed to gain it. Their skins were pallid, sometimes discolored and corrugated. Their countenances had the appear-

ance of old age, rather than the bright and lively bloom of childhood. They suffered from diarrhœa and dysentery and great debility, and many died.

The French have had this matter under consideration; for they found that although the distillery-fed cows had a great flow of milk and were profitable to the owners, yet the children that drank it suffered a great deal from waste of flesh and strength, and the loss of infant-life was great.

Some years ago, several persons in Malta were poisoned. On investigation, it was found that they had drank the milk of goats that had eaten of the Euphorbia Helioscopia, a poisonous plant that grows in the pastures of that island. The characteristic poison was imparted to the milk, and through this it was given to the consumer.

The same relation of diet to milk holds with woman as well as with domestic animals. As the nurse feeds herself, so is the food she offers from her body to the infant that is nourished by her. Those who are meagrely and improperly fed offer meagre and unfitting food to their nurslings. Women who drink beer, porter or spirit for appetite, or with the honest intention to increase the milky secretion, run the risk of providing a vitiated nutriment for their infants.

Even the morbid condition of the mother may be conveyed through her milk to the child. A physician in Massachusetts being called to a nursing-child, suffering from diarrhœa, was informed by the mother that she had the same trouble, and also that she had eaten green corn, which usually had this effect upon her. The physician did nothing for the child, but directed the suspension of this food. The disturbance ceased at once with both. But the mother being very fond of this diet ventured again twice, and at both times the same effect followed in both mother and child, and in both ceased on the suspension of the corn.

Even the medication of the mother is felt also by the child. In July, 1872, there was in Roxbury an infant fatally narcotized through the mother. Suffering from great distress, she consulted her physician, who gave her fifteen grains of chloral hydrate aud one-fourth of a grain of sulphate of morphine. In three-quarters of an hour after taking this medicine, she nursed the child, which to all appearance was perfectly well

at the time. But soon afterwards he went to sleep, and manifested the usual effects of narcotism, and died in about twelve hours. Although strict inquiry was made, no cause of poisoning could be discovered except through the milk taken from the mother.*

Purgatives taken by the nurse sometimes act also on the child.

It is manifest that the character of the milk and the health of the child depend very materially on the manner of the mother's self-management, and that much of the ill-health of nursing-children and some of their mortality are connected with the errors in the maternal digestion. Among the poor, who have no choice of food, but must take such as their limited means allow; among the ignorant, who consider, if they think at all, that the stomach is indifferent as to the matters that are put into it, and will digest all alike; among the sensual and self-indulgent, whose appetites or caprices are their ruling motives in selection of food, it is easy to suppose that some will occasionally, more probably very frequently, err in diet. They fail to nourish themselves as they should, and to produce in their own persons the nutriment best suited for the health of their babes. Their children therefore are often badly nourished, they suffer from inanition and debility, and from disorders of the digestive-system, which may end in death.

The deaths from diseases of the digestive organs among children under five in Massachusetts were over 7,900 in the last three reported years, and in England, over 80,000 under one and over 115,000 under five, in the years 1867 to 1870.

These numbers show that the nutritive system is exceedingly susceptible of disturbance, and while it is the absolutely needful agent in the maintenance of life it may become, under improper management, as from other causes, a frequent agent of death.

The Poor.

The poverty of the poor, as a class, reaches beyond their outward pecuniary condition. They have a small portion of the world's goods, and as a consequence, in a very large pro-

* Boston Medical and Surgical Journal, LXXXVII. 116.

portion of cases, and as a cause of this fact, in many others, they have a lower bodily health and shorter duration of life.

They are compelled to engage in the hardest and most dangerous labors. They suffer more from exposure and from accident. They have less means of sustenance for themselves and their families. Their houses are necessarily cheap, often in the less desirable and healthy places. They live often in wet and unwholesome localities in the country, and in the narrow and crowded streets of cities. They can have but small space around and in the house for themselves. They can have but few rooms, some have but three, others have but two, and many have but a single room for the whole family of father, mother and children. In these, or in this, they do all their domestic work. Here they cook and eat, they wash, dress and sleep, and here they are sick and here they die. Their narrow quarters are filled with the fumes of the cooking processes, sometimes with the smoke of the fire, and often with tobacco-smoke of the self-indulgent father and his visitors. Add to these the emanations from the lungs and the skins of the family, and it is manifest that the air they breathe is corrupted and overloaded, and there is but small opportunity for the dwellers to purify their blood with a good supply of oxygen.

The air of such crowded rooms becomes loaded with an intensely oppressive odor, that attaches itself to the persons and clothing of those who live in them, and is carried abroad through long distances of travel in the open air. There is little opportunity for ventilation, or even motive, for the air abroad, that would first enter their room, is also foul and unhealthy.

The surroundings of these tenements of the poor are often no better than their inward condition; offal is thrown out, filth accumulates, and sends forth its effluvia to poison the air above it.

In the city, their streets are narrow, and the yards of their houses still narrower, and frequently wanting. Their rooms or tenements, both in city and country, are frequently cold. They are sometimes old houses, deserted by the more favored previous occupants, as unfit to be inhabited. Some are new

but badly constructed, and built with as little cost as possible, to accommodate the narrow circumstances of the poor.

Their clothing and other means of personal protection are equally uncertain, and often inadequate for their comfort or their health.

In the market they must consult their finances rather than their digestive powers or their wants of nutrition. They therefore buy the cheaper rather than the most nutritious food, and the cookery is often as imperfect as the material which they prepare.

So all the means that they have of sustaining and of protecting life—the air they breathe, the food they eat, and the shelter and clothing that protect them from the elements are of a lower character than the more favored are able to obtain.

Hence their life and strength are less developed and sustained. They have more sickness and less power to resist its ravages, and they sink earlier beneath its force.

Dr. Marc D'Espine, the celebrated and learned Swiss writer on mortality, says :—

> "Wealth and comfortable circumstances increase vitality and longevity. They raise the mean or average of life. They lessen the mortality at all ages, and especially in infancy. But poverty and misery have the contrary effect." *

The children, especially the infants, with the extreme delicacy of organization and great susceptibility of influence, particularly for evils belonging to their years, feel the force of all these depressing conditions and circumstances more than the adults.

The hard necessities and the severe labors of the mother often prevent her from giving the prenatal child opportunity of development, and after birth she cannot give the little nursling the attention that is needed for the establishment of its physical constitution on the best basis for endurance. Moreover with the ignorance and uncertain discipline of the parents and household, the child is submitted to regimen as to diet, clothing, air and exercise unsuited to its wants and powers, and frequently injurious to its health.

* Annales de L'Hygiene, xxxvii. 325.

Dr. Fraser says, in respect to a district of Glasgow, under his inspection :—

> "Within no very limited area, none of the children that I saw were well, and I found that more than one-half of the whole, born alive, had died very young. One woman had five living children, but had lost six. In another family three survived and seven had died."
>
> "It is no uncommon thing to find in families having originally seven, nine, eleven and even thirteen children, one or two only reaching adult-life. Fearful as this is it is to be found in nearly every considerable city in the kingdom." *

The records of sickness and mortality confirm these deductions, which are drawn from seeing the condition and habits of the poor. Mr. Chadwick, in his report on the sanitary condition of the laboring classes, page 161, says, that he found in fourteen cities and districts that the average age, at death, of 1,232 members of the most comfortable classes including the children and infants was 44 years. Of 5,035 persons in families less comfortably circumstanced, it was 27.47 years, and 20,385 persons in families of the poor had enjoyed an average life of only 19.58 years. The average longevity in the most favored class exceeded that in the poorest by 125 per cent.

The difference was most in the deaths of the children. Compared with the number living under one year, the deaths were 20 per cent. in the best, 44.4 per cent in the middle class, and 50 per cent. in the poorest.

The experience of Paris gives a similar result. Villermie says, that in three arrondissments, where only 7 to 11 per cent. were exempt from tax on account of poverty, the deaths of infants, at their homes, were only one in sixty-four of the living, while in other districts, in which 31 to 33 per cent. could pay no tax, the deaths, were one in forty-five.

The deaths of infants at home and in hospitals were one in forty-three living in the richer, and one in twenty-six in the poorer districts.

There are no records in this country that show the mortality of the comfortable and the poorer classes separately. But in Massachusetts and in Boston, the births and deaths in the American and foreign families are separately recorded.

* Trans. Social Science, 1860, page 650.

The record of the American families include all the native poor as well as the prosperous. But a much larger proportion of the foreigners are poor.

In Boston, during ten years, 1862 to 1871, there were born 20,867 children of American and 42,582 of foreign fathers. In the same time, the deaths were 3,438 under one year, and 5,428 under five years, of the first class, and 7,719 under one year, and 13,943 under five years, of the second class.*

Of those that were born in American families, 16.47 per cent. died under one, and 26 per cent. under five years. Of those born in foreign families, 18.13 per cent. died under one, and 32.79 per cent. under five years.*

The mortality of the foreigners' children was 10 per cent. greater under one, and 26 per cent. greater under five than that of children of natives.*

In Massachusetts, in the four years, 1867 to 1870, of the children born of both foreign parents, the ratio of deaths under one year exceeded that of the children of Americans by 10 per cent., and under five years by 28 per cent.*

In this connection the comparative ratio of infants and children to those of all ages buried in the Mount Auburn and the Catholic cemeteries in the vicinity of Boston agree with these deductions. During the periods examined there were of all ages, 19,735 buried in the Catholic cemeteries, of whom 5,688 or 28.7 per cent. were under one, and 11,486 or 58.2 per cent. under five. At Mount Auburn 16,949 were buried, of whom 1,973 or 11.6 per cent. were under one, and 4,771 or 28.1 per cent under five.†

The Catholic families are immigrants, and therefore have a very small proportion beyond middle age. But they have a much larger proportion of young children than the families whose members are buried at Mount Auburn, but the proportion of this excess of their living is much less than is shown of their dead children.

Records of the mortality of Concord, Mass., for sixty-five years, and of Dorchester, for seventeen years, show the occupation and social positions, as well as the age of the deceased.

* Annual Mortality Reports.

† Condensed and calculated from the records of the cemeteries.

The proportion of deaths under two years in the families of the farmers that owned their farms, was 11.94 per cent. of those of all ages, and in the laborers' families the proportion was about double, or 23.5 per cent. In order that the farmer should own his farm, it is necessary that his wife, who is his partner and coöperator, should be wise, discreet and thrifty. This wisdom and discretion, which she brings to the management of the general affairs, is shown in the care of her children, and this is the result.

Education and Ignorance.

The infant's life is in the care of the mother, and its safety depends upon the intelligence and discretion that she can give to this responsibility. There is no record that discriminates between the intelligent and the ignorant of the mothers, showing the number of each class. Nor is there any record of the deaths of the infants of these educated and uneducated parents. But there is an approximation to these facts on a large scale in the registration reports of England.

In England every person when married is recorded, and required to sign the register; and if unable to write, the groom and bride must make the mark.

The reports show the numbers and proportions of both grooms and brides in each district, who wrote their names or made their marks.

The same records show the births and the deaths at each age. For the purpose of showing the connection between the education of the parents and the life of their children, the records of twenty-five years, including 3,362,742 marriages, have been analyzed, and divided into several classes, according to the proportions of the brides who wrote their names in the register.

In the most intelligent class, there were 648,260 marriages, and 20 to 30 per cent. of the women made their mark. In the least intelligent class, there were 661,929 marriages, and 60 to 70 per cent. of the brides made their mark. In the first class there were 2,231,959 children born, and 327,040, or 14.65 per cent., died under one year old. In the last class 1,776,547 children were born, and 439,359, or 24.87 per cent., died before they passed their first year. As often as 1,000

died in their first year, in the more intelligent class, 1,698 died in the least intelligent class among the same number born in each.

These classes are both large ; each includes city and country, commercial, mining, manufacturing and agricultural districts. The only difference apparent is the diverse proportion of the mothers who could write their names.

It is not to be supposed here, that the simple fact of inability to write caused the death of infants. But this inability to write is a representative fact. It represents a want of education and intelligence, a lower degree of discipline and thrift ; with these mental and moral conditions are associated more poverty, and even destitution, the more frequent want of means of support and the comforts of infant life, a more careless and indiscreet management, more intemperance, and neglect of children. In the best class 20 to 30 per cent. could not write, and in the worst class 30 to 40 per cent. had this accomplishment, but if these could be excluded, and none but the educated be in the first, and none but the ignorant in the last class, the difference in the chances of infant-life would be found to be much greater.

Overlaid—Suffocation.

A cause of death of infants is found in the British and Irish reports, termed *overlaid*, or smothered by the parent or nurse in bed. The reports of England show that in the eight years, 1863 to 1870, 1,125 were destroyed in this manner ; this is 140 a year. But perhaps these are not all. In these eight years, there were 7,580 deaths from suffocation ; 5,588 of these were children under one year, 1,125 were overlaid, and 3,606 were said to be "*suffocated by bedclothes.*"

How many of the last were overlaid is not known. But from evidence given in a discussion of this matter, at a meeting of the Social Science Association, 1864, it may be feared, that many more infants were overlaid and put to death by their parents than these figures indicate. Dr. Lankester, the learned and scientific coroner of London, said, "I find that in one year I held inquests on ninety children who have been suffocated in bed." Mr. Raper said, "It appears that seventy-two cases of deaths of infants that had occurred from suffoca-

28

tion between Saturday and Monday, were brought before the coroners' courts of Liverpool."

Dr. French: "The parents having been paid their wages Saturday, get drunk and neglect their children." Dr. Raper: "The great bulk of these, nearly the whole, occur through the drunkenness of their parents. The beer-bill created 8,000 beer-shops in Lancashire." "The removal of that law would remove the temptation to that vice, that produces a great deal of our infant mortality." Dr. Lankester: "A large number of these children are found dead on Sunday morning, and, I fear, many of them are caused by the Saturday-night orgies. Drunkenness is the frequent and fruitful cause of infant mortality." *

The term *overlaid* does not appear in the mortality reports of other countries. But suffocation is given as the cause of ninety-two deaths of all ages, of whom sixty-three were under five, in Massachusetts, within the five years ending with 1870. The last census of the United States reports 1,255 deaths from this cause, in the year 1870–71, of which 931 were of infants under one, and 1,023 were under two. In the "Southern Medical Reports" printed in New Orleans, about twenty-five years ago, Thomas Affleck, Esq., of Washington, Mississippi, in an article on the hygiene of cotton-plantations states, that "the mortality of negro children is two to one when compared with the whites;" "not a few are overlaid by the wearied mother, who sleeps so dead a sleep as not to be aware of the injury to her infant." This finds some corroboration from the mortality report of the last census. In the year 1869–70, in eight Southern States, with a population of 7,222,409, of whom 3,271,321, or 45.3 per cent. of all, were colored, there were 552 deaths from suffocation; 479, or 86 per cent. of these, were of children under one year. In ten Northern States, with 17,622,493 inhabitants, of whom 306,254, or 1.7 per cent., were colored, there were 406 destroyed by suffocation; 228, or 56 per cent., were under one. Most of the others were adults suffocated in mines by charcoal fumes, etc.

In the States where the colored population forms a large proportion of the whole, the deaths from suffocation were

* Transactions, 1864, p. 651.

one in 13,084 living, and the babes were 86 per cent. of the whole. In the other States, with a very small proportion of colored people, the deaths from this cause were one in 48,405, and the infants were only 56 per cent. of the victims.

Illegitimacy.

Quetelet, speaking of illegitimate children in his work, Sur l'Homme, p. 231, says, "The deadly heritage of vice attends the infant before birth, and pursues him for a long time afterwards."

The depressing circumstances, conditions and influences that sometimes attend and impair the life of children born in wedlock, are more intensified and destructive, and hover more frequently about those who have no legitimate fathers.

The mother, oppressed with shame and sorrow, endeavors to conceal her state, by all the means of dress and compression. Practically denying her condition she can ask no favor of family or society, but assumes and bears the burdens and labors that are assigned to the healthy and unencumbered. The child is deprived of the requisite opportunity of development and growth. Means are often used for its premature removal, and result in its injury, and when at length it is born, its constitution is generally lower than that which belongs to the children of honest parentage.

As soon as the unwelcome child is born, its exceedingly feeble life is surrounded with foes on every side, and finds few friends to protect and sustain it. An object of fear and anxiety to the mother, who is allowed but little or no opportunity to attend to its wants and caress it, an object of aversion and even of disgust to the family and associates, there are few or none to offer their tender and affectionate attentions to this frail waif of humanity, and make its differcult path to strength as easy and sure as to other children. Family, friends and society, or the inexorable force of circumstances, deny the claim of the child upon its mother for parental care. But they demand of her that she shall bear her part of the burden of the world and work with her hands, as if she had no maternal love and no object to expend it upon.

Most frequently society recognizes in this forlorn, deserted woman, no other attribute of motherhood than the fountain

of nutriment which nature has provided in her person for her own offspring. But even this she feels compelled to sell, with all her power of motherly sympathy and attention, in order to obtain bread for herself and her babe. Thus the well-born child of affection and honor drinks the milk and enjoys the exclusive watchfulness that naturally belongs to another, while the base-born child of infamy and sorrow is deprived of its only heritage of good; it is made an outcast, and sent to live with hirelings. Although these strangers have no motive but gain, they are poorly paid for their responsibility. They have neither the intelligence nor the heart, still less the time to give that which the infant most needs,—a mother's judicious and affectionate care. They may feed it with the natural food, but generally with the milk of animals and diet less digestible and less fitted to sustain its life and health. The child's feeble constitution has a hard struggle with these unfavorable conditions and circumstances, and often sinks beneath their weight.

In Prussia, during fourteen years, while 17 per cent. of the legitimate infants died in their first year, 25 per cent. of the illegitimate died at the same age. In Berlin, 19.8 per cent. of the first class, and 36.2 per cent. of the other died in infancy. In Stettin, in the five years, 1854 to 1858, these proportions were 22.3 and 45.1 per cent. respectively.

In Bavaria, through five years there were born in wedlock 633,119, and out of wedlock 190,349 children. The deaths in the first year were: legitimates 207,750, or 32.8 per cent.; illegitimates, 72,663, or 38.29 per cent.*

In Austria in 1861, 1862 and 1865, and in Hungary in 1865, the births were:†—

Legitimate, ...	2,705,536
Illegitimate, ...	371,275

Deaths under one:—

Legitimate, ...	645,663, or 23.86 per cent.
Illegitimate, ...	129,419, or 34.85 per cent.

Quetelet, quoting from Sussmilche, says "that for every ten of the legitimate that die in each of these several periods,

* Statistiche Konig Bayern, 1861.

† Oesteriche Jaarbuch, condensed.

there are deaths of the illegitimate in the first month, twenty to forty; in the second and third months, twenty; in the fourth to sixth months, seventeen; in the seventh to twelfth months, fifteen, out of the same numbers born in each class."*

The reports of France and other nations tell the same story, showing the universal law, that infants born out of wedlock suffer the necessary consequences of neglect, the frequent privation of maternal care and appropriate food. They have therefore a lower vitality, and a larger proportion of them die in infancy and childhood, than among those that are allowed to enjoy the tender, faithful care and appropriate food that nature intends for her little children.

Foundlings—Abandoned Children.

Beneath the low depths of wickedness and suffering just described, there is a still lower depth connected with the children,—those that are abandoned by their mothers and left in the street to take their chance of death, or of being rescued by the pity of strangers, or sent to the foundling-hospitals with a somewhat better chance of life. This is usually the last act in the long process of concealment practised by the mother whose condition and suffering have been known only to herself and one or more confidants.

Some of these infants have been the subjects of attempts to procure abortion. From all these causes these children come to the world, with the lowest vital force, the smallest hope of continued life. Then they are rarely fed,—almost never properly,—as they are hurried away before the natural nourishment is provided. To prevent the crying that might lead to discovery at home or on the way from the place of birth to the stranger's doorsteps or to the foundling-hospital, the child is often stupefied with opium. On the way to either, or while waiting in the street, if left there, the little spark of life suffers another cause of extinguishment, from exposure to the air to which it is unused, and to cold which it cannot resist.

However discreet and kind the people may be into whose hands the child may fall when left at their door, they are not

* Sur l'Homme, 231.

prepared for such a responsibility; they cannot meet its necessities, they are not nurses, they have not the natural food. Through the transition from its first resting-place, through the police, the station-house, to the asylum, if such there be, to the almshouse, or possibly to some charitable heart, that is willing to receive, and even adopt it, the infant finds no strengthening, but is subject to continual exhaustion, and when it arrives at its destination, its life is very low, and gives but little promise of continuance.

With such children nothing but the best appliances will avail. More than others they need the human milk, yet few can be indulged with it, and even they, with rare exceptions, can have only a part, a small part, of their nourishment from this source. Their main dependence must be on the bottle-nursing. But the best care, protection, warmth and food are necessary, and even these sadly fail in a large proportion of these waifs. In the best institutions, even in the Massachusetts Infant Asylum, managed with the best charity and wisdom of the State, provided with the tenderest and most discreet attendance, with airy, properly warmed and ventilated rooms, with clothing most suitable and food most digestible and nutritious that can be obtained, including wet-nursing as part of the nutriment, with all these means of sustaining life, 48 per cent. have died in its four years' operation. The New York City Foundling-Hospital was opened in November 1869; in the first year 1,480 infants were admitted, and 826, or 55 per cent., died within that period.*

In almshouses, that have no especial provision for the care of these feeble children, where the extreme tenuity of their thread of life is not understood, and especially where economy is the ruling principle, the rate of infant mortality is much greater.

Foundling-hospitals are plentiful in Europe. They have received multitudes of abandoned children. And the general history of their operations shows how small is the vital force of those committed to their care, and how few of them can be saved.

In Rome, the mortality was 57 per cent.

* Rep. Board of Health, 1870, p. 279.

Sir James Simpson, in his lecture on health, before the Social Science Association, in 1867, said, "I mention the frightful mortality in foundling-hospitals, where all the laws of health are set at defiance. In the old Dublin Foundling-Hospital, of the last century, only some 135 lived out of 12,000 infants admitted." *

This, however, has been improved, for out of 52,000 admitted in thirty years, 1795 to 1826, only 41,000 died.†

Effect of Cold.

Children need fresh air for respiration, but little infants suffer from cold. "It is the custom in France to carry infants, within a few days of their birth, to the office of the mayor of the town, in order that the birth may be registered and the child become possessed of its civil rights." This is done through all seasons. The proportion of death within a limited period after birth was much greater in winter than in summer. "It was greater in the northern than in the southern parts of France." "It was greater in the sparse districts, where the children were carried long distances, than in the densely peopled places." ‡

In Russia, the deaths of children varied from 31.6 in the warmest provinces to 69.1 per cent. in the coldest. These differences follow the isothermal lines rather than latitudes. Wherever, from geographical structure, mountains and valleys, exposure to or protection from winds, the climate was colder or warmer, the same variation of infants' life and death was manifested; the cold air destroyed, the warm air saved many.

Here, however, we are met with the fact, that in Norway was the lowest rate of death within one year after birth. This is to be explained by the domestic character of the Norwegian mothers. They are mostly wives of farmers, discreet and faithful to their responsibilities in the care of their households, and especially of their children.

The constitution of children is strengthened by exercise in the open air, under proper conditions of protection, yet the

* Trans. 1867, p. 122.

† Porter's Progress of the Nation, III., 288.

‡ Edwards' Influence of Physical Agents on Life, 216.

plan of hardening, which some attempt, is destructive. It destroys the weak and weakens the strong.

Country and City.

It seems to be a universal law that condensation of population lessens the chances of life. The ratio of mortality is greater in city than in country, and this increases as the people live nearer together in the city.

The supplement to the English Registrar-General's twenty-fifth report, pages xxxviii to lviii, gives a table showing the number of deaths in 10,000 living, and average number of people to an acre of land, in each of the six hundred and twenty-three districts of England and Wales.

In the districts which had 100 to 250 persons to the acre, the annual deaths were 262 in 10,000 living.

In those which had one to two acres for each inhabitant, the deaths were 214 in 10,000.

In the thinly settled districts, with twelve or more acres for each, the deaths were only 168 in 10,000.

In the cities the mortality increased with the crowding of the living, as shown by the reports of deaths in the four places below.

TOWN.	Living to Square Mile.	Annual deaths in 10,000 living.
London,	50,000	251
Leeds,	87,256	272
Manchester,	100,000	337
Liverpool,	138,000	348

The excess of mortality falls in greater proportion on childhood than on maturity.

The deaths in the healthiest districts were 10,604 in 100,000 children under one year.

In Westmoreland and North Wales they were 11,884.

In fourteen city districts, 25,858.

In Liverpool, 28,005.

The annual deaths under five in the period, 1849 to 1853, were, in thirty cities, 338,990, and in healthy country districts 135,478, in the same population in each. As often as 100 died in the healthy country, 250 died in the city, among the same number living.*

The life-table, founded upon the most rigid observations, makes the proportions of deaths of children to be 5.29 per cent. for the country and 13.34 in the city, or as 100 to 252.

The reports of births and deaths of Scotland make three divisions of the people.

1. Those living on the islands.
2. Those living in the country of the mainland.
3. Those living in the great cities.

During the fourteen years reported, the proportions of deaths of children, for every hundred births in each class, were—

	Under one.	Under five.
Islands, ...	8.05	15.58
Mainland country, ...	9.80	18.26
Cities, ...	14.91	30.90

As often as 1,000 died on the islands, 1,217 died on the mainland country, and 1,852 in the cities, under one; and 1,172 in the rural, and 1,983 in city districts, under five.

There are similar differences in France. The deaths in 1861 to 1865 were less than twelve per cent. in two departments; less than fifteen per cent. in six; less than seventeen per cent. in nine departments, and 39.07 per cent. in Paris, in the same number living under one year.†

A chart recently published by Bertilon, shows the different rates of mortality of children under one and under five in each department, by the varied shading from perfect white, for the healthiest, to perfect black, for the most unhealthy.

* Reg. Gen. Sup., XXV. Rep., p. xxvii.

† Mouvement de la Population, 1861–1865, p. lxvii.

It is a little noticeable that the department of the Seine, in which is Paris, is not the blackest, but it is somewhat lighter, and its rate of infant mortality is 268.6 in 1,000; while seven of the neighboring departments are black, with rates of 277 to 359 in 1,000. The explanation is easy. It is the custom of the officials of the maternity and foundling hospitals of Paris, to send a large part of the infants to the country to be cared for, and their frequent deaths swell the rates of infant mortality in these districts, while that of the city is thereby diminished. Nevertheless, even these have a better chance of life in the country than they would have in Paris.

In 1863 the public administration of charities in Paris had charge of 22,829 infants; 17,759 of these were sent into the country, and there 1,359, or 7.65 per cent., died; 4,397 were retained in the city, and there 469, or 10.6 per cent., died.

Dr. Berg, the chief of the Royal Statistical Bureau of Sweden, says: "The difference between the towns, especially the large towns, and the rural districts has an important effect on the mortality of children of that country."

Dr. Herz makes the same report of Austria. And the records of mortality of other European nations give similar accounts.*

"In the least unhealthy rural districts of England, the death-rates of children, in their first year, are not more than one in twelve or fourteen. In the least unhealthy urban districts, there dies one in eight or nine, in the first year. In Manchester, one in five dies, under one, and one-half of all that are born there are dead, soon after their fifth year. But in Berlin, Prussia, one out of every three dies within the first year, and half of all that are born there, are dead within two and a half years after their birth. In 1871, 31,262 children were born, and 10,072, or 32.2 per cent., died within that year." †

* Journal Statist. Society, London, March, 1866.

† Edwin Chadwick, in Journal of Society of Arts, London, Dec. 20, 1872, p. 87.

In Massachusetts these facts were as in the following table, during the ten years, 1861–1870 :—

	Births.	Deaths—under one.	Ratio of deaths under one, to births.
Boston, ...	60,354	11,537	19.11 per cent.
Thirteen other cities, ...	80,088	13,863	17.30 "
Rest of State, ...	198,030	24,547	12.39 "

The rate of infant mortality, in comparison with the births, in the thirteen smaller cities, exceeded that of the open country by 39.60 per cent., and that in Boston had an excess of 54.23 per cent. Among the same number of children, born in each of these classes of places, as often as 1,000 died in the country, 1,396 died in the smaller cities, and 1,542 in Boston, under one year.

There are differences in the same city. In four of the districts of London, the deaths under five were from 50 to 59; and in four other districts, these rates were from 101 to 108 in 1,000 living, of the same age. Between these extremes, there were all intermediate grades of mortality in other districts. This is due in part to the different densities of the population, and in greater degree, to the difference in their domestic condition.

Similar differences were found in Boston in 1870, the year of the census. The State Board of Health divided the city into twenty-four districts, according to their sanitary condition. Some of these were low and wet, others were hilly and dry. Some were laid out with wide streets, open grounds, broad sidewalks, and were inhabited by the wealthy and comfortable classes. Others were filled with narrow streets, lanes and courts, and in these were crowded the dwellings and families of the poor. In the most favored districts, the deaths of infants under one, were 86, 100, 167 and 171 in 1,000 living at that age. In the unhealthy districts the mortality was 359, 379, 409 and 486 in the same number of living infants.*

* Report State Board of Health of Massachusetts, 1871, p. 350.

In the most unhealthy districts are the abodes of the poor. Their hard and exhausting labors, their domestic and personal privations, make all external aids of health more necessary to them than to others. But their necessities compel them to live in small tenements, with one, two or three rooms for a family. Dirt, filth, offal constantly gather in their narrow and undrained streets, lanes, alleys and courts, and in their yards, if they be so fortunate as to have them. The public authorities and their agents the scavengers and sweepers, feel little motive to cleanse the places that so soon become foul again, and often, with all their faithfulness and energy, find it impossible to keep the pavement in satisfactory condition. The air without is befouled with the emanations from the ground. And the air within the dwellings is corrupted with the exhalations from the persons of the family and their necessary processes of labor.

There is but little chance for the children or adults to decarbonize their blood with fresh air within, and not much inducement to look for it abroad. The broad streets, where pure breezes blow, the wide sidewalks, where children can play, the parks, commons, squares, that are kept open for the health of the city, are not in their neighborhood, nor within their physical or moral reach, nor are they for such as these who need them most.

Here the family of all ages, and the infants more than the others, have a hard struggle for life, but find no fulness thereof; for "impure air resulting from overcrowding, imperfect ventilation and decaying refuse of every kind, is by far the most fatal and widespread of the morbific agents to which the young are exposed; and this is the most potent among the physical causes of disease." "Moreover, the enfeebled state of the system, induced by the deteriorating effects of vitiated air, is most unfavorable in rendering children unable to withstand the force of epidemic and contagious diseases, to which they are so liable," * and which have their favorite haunts in the crowded districts of cities and among the poor. Hence their high rate of infant mortality.

* Dr. Fraser, in Social Science Trans. 1860, p. 650.

Effect of Civilization.

One of the most happy consequences or evidences of the advance of civilization is the improvement in human health. The rate of mortality is diminished in every successive age of the civilized world, and especially in infancy and childhood. More infants now survive to the full development of maturity than in the previous centuries. The period of vigor is protracted, old age is deferred, death comes later and the average longevity is increased.

The records of Geneva in Switzerland are the most full and satisfactory for the earlier periods of the world.

The deaths in 10,000 born were,—*

PERIOD.	Under 1.	Under 5.
Sixteenth century,	2,592	4,435
Seventeenth century,	2,372	4,100
Eighteenth century,	2,012	3,316
1814 to 1833,	1,385	2,440

In the first period, one-half died before they completed their ninth year. In the last, one-half survived their forty-fifth year.

Dr. Farr, in Macculloch's Statistical Account of the British Empire, II., 543, says, that the proportion of children raised, has doubled within a hundred years. In London, the proportion of deaths under five were,—

1730 to 1749,	74.5 per cent.
1770 to 1789,	51.5 "
1851 to 1870,	29.8 "

"So great was the rate of infant mortality in London, that an Act of Parliament was passed in 1767, ordering that all parish infants should be nursed six years in the country.

* Mallet in Ann. Hyg., XVII., p. 98.

Before this, almost all parish children died in their first six years." *

According to the Life-Tables, 32 per cent. of all that were born in the ten years, 1728 to 1737, died under one. One hundred years later, only 12.5 per cent. died at this tender age.†

The diseases—especially the epidemic and contagious diseases—were formerly more prevalent and virulent among children in the earlier ages than at the present time.

In London, from 1675 to 1732, convulsions, mainly a disease of childhood, caused 23.91 per cent. of all the deaths.‡ From 1862 to 1870, only 3.3 per cent. of the whole died from this disease, and in Massachusetts, only 1.8 per cent. since 1843.

In the ruder and less intelligent society that existed one and two hundred years ago, the morbific influences that wasted the lives of children were more prevalent and effective than in the later times. Civilization includes among its manifold blessings, the increase of human life; all ages enjoy its benefits, but none so much as infancy and childhood.

The growth of intelligence, the increase of wealth, with ameliorations in the personal and domestic condition of the people, the improvements in the comforts of home, in dwellings, in clothing and food, the purification of morals, the softening of manners, the higher conscientiousness and broader and warmer charity,—all are blessings in themselves, and still more in their effects on the human organization. Each one and all these elements of civilization, in as far as it pervades and influences society, families and persons, contributes its due proportion to the development of the constitution, and enables it to ward off the attacks of disease, or to resist its destructive power when it comes.

On the contrary, wherever any of these elements are wanting, wherever ignorance, poverty, privation, negligence or exposure exists, its effect, according to its degree, is felt by the exceedingly sensitive constitution of early life.

Civilization, which in itself is an unqualified good to both manhood and childhood, is yet not unaccompanied with evil.

* Price Annuities, II., 32.

† Price Annuities, II., 45, 297.

‡ Corbyn Morris. Past and Present Growth of London.

More plentiful means of life bring temptations and opportunities for indulgence in food and clothing that may be injurious. Fashion, which is not founded on wisdom as its permanent rule, sets at naught sanitary principles when they stand in its way. It often clothes children in a manner rather to please the external eye, than to protect them from the elements and give the tender body that genial warmth that it needs. Sometimes the child is buried in clothes and heated beyond measure. Sometimes one part is overloaded, while another is naked. The head is sometimes oppressively wrapped in cape or hood, while the arms or legs or parts of them are exposed to the full power of the cool atmosphere.

The Child Needs the Mother's Care.

A child is the most precious gift offered to mankind, and brings with it the most sacred and exacting responsibility. To develop its constitution and protect it from morbific influences, require special knowledge of its nature, wants and dangers, and unremitting care and faithfulness in its management.

Nothing is accomplished without the best intelligence and preparation for the purpose. Youth is the time to prepare for the burden of life. Men, regarding this law, seek their way, through pupilage, study, observation, apprenticeship and labor to their field of service in agriculture, mechanics, trade or other pursuits; and when sufficiently trained and educated, they are allowed and encouraged by the world, to become responsible managers and operators in their respective occupations. Then they succeed, in proportion to the intelligence and devotion they bring to their work, and the skill which they apply to the business they undertake.

From the beginning, the law was established that people should marry, and that children should follow marriage. Whatever may be said of the sphere of woman, this precious charge of new-born humanity has ever been entrusted to her. She has ever claimed or accepted this trust. Her physical and moral organization, her possession of the natural nutriment, her tender affection, her inimitable tact and facility of adaptation, give her alone the power to fulfil this responsibility; and more than all others is the mother fitted for this duty.

Intelligent Mothers.

Yet even the mother requires something more than her natural capacities, her loving instincts and her ready sympathies. It is necessary that she be acquainted with the infant nature—its wants and liabilities. But ordinarily she comes to her first motherhood, without preparation, without knowledge of what needs to be done and how she shall do it. With all her good-will and conscientiousness, numerous mistakes are made, the child suffers from errors in diet, clothing, from exposure, from too much or too little nursing. Disease may attack the infant, whose feeble constitution is unable to resist it, and sinks beneath its destructive force.

The records of infant mortality offer a melancholy illustration of the necessity of the mother's previous preparation for the care of her children. The first-born die in infancy in much larger proportion than their successors in the family. The mother learns at the cost of the first child, and is better prepared for the care of the second, and still better for the third and fourth, whose chances for development into the fulness of strength and life, are greater than those of the oldest brothers or sisters.

Children's Nurses.

When the strength or time of the natural family is insufficient for all its diverse operations, and strangers are called to aid in various ways, they are selected on very different principles. Before the dress-maker is employed, assurance must be given that she has so learned her art, that by no error in judgment or of hand, the garments and outward adornments will fail to fit the frame or meet the unrelenting law of taste.

But no such caution is manifested in the employment of a nurse for the little children. The same measure of skill in her occupation is not required. She is not expected to understand the infant's constitution, or to be familiar with its wants, weaknesses and dangers. Nor is the same assurance of discretion and faithfulness demanded of her as of the maker and fitter of garments, before she is allowed to begin her work.

It is not surprising, then, that she sometimes errs in judg-

ment, in respect to the food of the child at home or elsewhere, or to the clothing, the protection from or exposure to the cold or the heat abroad, or that she be occasionally careless or even wilfully negligent. As a necessary consequence, the child's health suffers in proportion to the ignorance and unfaithfulness of its guardian, as the dresses would if the mantua-makers were selected with no more evidence of fitness, or as the father's business would, if his agents had no better preparation for their responsibility than the nurse.

With all the perils that surround the frail organization of the infant, nothing short of the mother's undivided interest and watchfulness can give it the best protection from danger and the best assurance of health and life. This is her highest responsibility; and its wise and faithful fulfilment insures the richest and most enduring reward.

Civilization has more to do for Human Life.

Civilization has done and is still doing much for human life, but it has not yet wrought its perfect work. There yet remain in the nation, in families and in persons, many of the causes of low vitality, and especially in infancy. There are yet poverty and ignorance, with their painful inability to develop the human constitution to its fullest power. There are yet crowded, uncleaned and unventilated districts of cities, with their withering influences on childhood. There are the ignorant, the selfish, the sensual and the self-indulgent parents, to whom the care of infancy is a burden. But these, and many other obstacles to the progress of humanity are gradually diminishing, and with this improvement, infancy becomes stronger and more able to resist the attacks of disease, and fewer children sink by the way from birth to the fulness of maturity.

THE

FOOD OF THE PEOPLE OF MASSACHUSETTS.

BY GEORGE DERBY, M.D.,

SECRETARY OF THE STATE BOARD OF HEALTH.

THE FOOD OF THE PEOPLE OF MASSACHUSETTS.

The health and power of a nation, as of an army, depend greatly on its food.

The object of this inquiry is to direct public attention to a department of sanitary knowledge whose general importance every one admits, but which is still only vaguely understood. Our plan has been to learn what forms of food are in common use throughout the State, how they are prepared, and how they are eaten, and then to consider whether this food, as generally used, promotes public health, power and happiness.

In the examination of this question of the fitness of food of various kinds to serve its proper uses, we propose to rely chiefly on the teachings of experience and observation.

Popular writings on dietetics, founded on what is known (or rather half known) of physiological chemistry, can do little or no good. The exact science of the laboratory cannot be applied to the vital chemistry of our human bodies, whose functions are under the control of forces the most powerful and the most obscure. The nervous system of a living man works changes in the condition of the parts of which he is composed, and often in the material provided for his sustenance, which confound the chemist who seeks to explain them by the laws governing inert matter. We know that our capacity for mental and bodily work depends on our supplies of food, but the transmutation of food into energy involves processes which no one can trace. Theory has never successfully guided man in the selection of his food, although science may and does explain his instincts and his tastes. The attempt to reach beyond this point of the corroboration of existing knowledge (the fruit of experience), has led to plausible generalizations on which have been based many systems of popular teaching. These have had their day, and then disappeared, in whole or in part.

For such reasons we shall make but little allusion to the scientific labors of the past or the present in this obscure field of knowledge, believing that the lights which they afford are as yet but side-lights, and offer only such glimpses of the whole truth as would tend to confuse rather than enlighten the unprofessional reader.

The habits of a people springing from varieties of race, from differences of religion and of climate, from soil and the conformation of the country, from occupation, from tradition, and from a variety of circumstances, trivial in themselves, yet powerful in the aggregate, form a subject of singular interest when looked upon as one of purely philosophic inquiry. These habits are of slow growth and are correspondingly persistent. No two nations use the same food, or prepare it in the same way, or eat it in the same fashion. Each nation regards its own diet as altogether the best, and ridicules that of other countries, and each is mainly influenced by pure conservatism, or a prejudice in favor of what is and has been.

We in New England have a certain selection of food growing out of the various circumstances referred to, and we prepare it in a certain manner, and eat it in a certain way. None of these conditions are absolutely fixed; they vary within certain limits, which are governed by individual tastes, by the scale of living as regards expense, and by intelligence. But every one will see, by comparing the table of a Massachusetts farmer or mechanic or laborer, with that of the corresponding classes in other countries, or in other parts of our own country, that the food in common use among us has a distinctive character.

We have taken pains to collect facts relating to the selection of food, and the modes of its preparation for use, in Massachusetts. The information comes from reliable sources— generally from our medical correspondents appointed by the selectmen in the various towns; in a few instances from other persons of intelligence. It is by no means complete; the subject is too extensive to admit of a full examination in a single year; but it may be regarded as a contribution to our knowledge of one of the three great influences, which more than all others affect the health of the people.

Air and its quality is certainly of the first importance, and has been referred to in previous reports of this Board. *Water* has also been considered in some of its relations to health. *Food* may certainly rank next.

The relative value of these three great essentials of life would be differently estimated by many persons, but we have no hesitation in placing air far in advance of food as a means of preserving health. Let any given number of persons of all ages, in the previous enjoyment of health, be constantly exposed to foul air with the best imaginable food, and their health will surely decline. Reverse the conditions; let the air be of the purest and best, and the food of the coarsest and worst prepared, but if it is in sufficient amount, and contains the chemical constituents of which our bodies are composed, health may still be maintained. Insurance of life in the open air should be on more favorable terms than in a printing-office or a tailor's shop, let the food be what it might.

Important as food really is to every one, and especially so to women and children and to persons who from their employment cannot enjoy the constant benefit of pure air, its influence on the maintenance of health is probably somewhat overestimated in popular belief. It is quite natural that this should be so. The process of taking food interests every one, and is constantly recurring. Food is visible, tangible, and appeals to all the senses. Its general uses are obvious to the most ignorant. Both its absence and its excessive use cause illness. It is therefore held responsible for a greater share of the many causes of ill-health than a more careful examination would assign to it. In point of fact, the toleration by the system of such varieties of food as can pass the sentinels of smell, taste, sight and touch, is a very remarkable thing to observe. Let the subject be a man in health, breathing pure air, and taking sufficient exercise, and with liberty to choose what he will eat for his own pleasure, and it is surprising to notice what his powers of assimilation really are. Give the same man equal range of food for his stomach, and deprive him of good food for the lungs by confining him in a crowded, ill-ventilated shop, and his health will surely suffer. With the advantages of air and exercise a man in health may retain his vital force with food in any

form which will supply the constituents of his body; and these constituents are not very numerous, and are found in many alimentary substances.

Or, to put it in another form: a hungry man, in health, having placed before him meat, bread, butter and water, will readily supply himself with all the materials required to repair the waste of his body, and will ask no questions, and need no advice.

But the great importance of nutritious and readily digested food for the people is seen when we remember that but a very small proportion of the whole population is found in the condition of the hungry man working in the open air with all his bodily powers in full force. *First*, there are the children who constitute one-third of the whole people. *Second*, the aged. *Third*, the women engaged in household duties. *Fourth*, the very large class of both sexes (the majority in all our great manufacturing towns), whose occupations compel them to work indoors, and in rooms imperfectly supplied with air.

Lastly, a class of persons of all ages and both sexes (how numerous only physicians know), whose bodily health is feeble from any cause,—people who may be able to attend to their daily avocations, but whose strength is impaired, and whose digestion is imperfect.

None of these persons can properly assimilate food which may be well fitted for lumbermen, open-air laborers, or soldiers on the march.

They require to be supplied with nutriment adapted to their condition of comparative feebleness, and in default of it they suffer.

The question is often asked of physicians whether a certain article of food is, or is not, absolutely wholesome, or good to eat. It is impossible to answer the question, put in this form. It is as unreasonable as to ask a sailor whether the wind is fair, without telling him in what direction you wish to sail. Very few articles ranked as food are absolutely unfit to eat; or, if not repulsive to the senses, may not be good under certain circumstances. A man laying stone-wall, or mowing in the field will not only digest, but thrive upon forms of food which would be very unwholesome for a man employed

in a shoe-shop, or a woman working in a factory, or at hand-sewing, or straw-braiding, or teaching.

Among the many causes of consumption this want of proper food is surely one. We know, by abundant experience, that the progress of this disease is stayed by appropriate nourishment, whether in the form of food, properly so called, or of its substitute, cod-liver oil. We know that a poor diet surely hastens the fatal event. And we have good reason to believe that the many forms of dyspepsia which are so commonly met with among all classes in Massachusetts, in country quite as much as in town, are but too often the danger-signal that nature gives us to show that *the food*, either in its quality, or its preparation, or its variety, is unsuited to maintain the vital processes. If this warning is neglected, the flesh wastes, the color fades, and the result of malnutrition is not unfrequently confirmed consumption.

The elements of repair of all the tissues of the body may be placed before a person of feeble digestion, and may utterly fail to accomplish their purpose; and the efforts of the stomach to assimilate and reduce them will only aggravate the original difficulty. It is but a modified form of starvation with the mockery of a display of abundant food.

The following circular was sent to our correspondents in the various towns as a means of collecting information on the subject of food.

FOOD.—Is the food in common use among the people conducive to health? Under this head we would like your observations on the following points, among others:—

1. Is the food in common use sufficiently varied in kind?
2. Are the proportions of fresh and salt meats, of vegetables, and of the various forms of farinaceous food such as you approve?
3. Have the farms good vegetable-gardens, and the means of storing vegetables so as to keep them in a fresh and wholesome condition?
4. Are the modes of cooking food of all kinds as good as can be employed?
5. What kinds of bread are chiefly used,—wheat, or corn, or rye, or mixed?
6. Is bread generally well made and well cooked?
7. Are any forms of pastry extensively used as substitutes for leavened bread?
8. Is the use of tea and coffee judicious in amount, and quality, and strength?

The replies to this circular have been very numerous. Many were monosyllabic, or nearly so, and we have tried to

put them in tabular form, but it has been found impossible to fairly present the opinions of our correspondents in this way. The more extended replies which we give seem to freely express the belief entertained by physicians in every part of the State.

On this question of food and cooking there is much reticence, and it may be attributed to causes which all may respect. The country physician breaks bread with the families who employ his services. He is often their honored and favored guest. The indisposition which he might feel to tell the good housewives at their own tables that their bread or meat were not good may also influence his pen. To complain of the food would be in a certain sense a breach of hospitality. However this may be (and all readers will judge whether it would influence the testimony), the information contained in our letters is given as follows :—

In a community like this, made up of comfortable farmers, the food is of a good kind and sufficiently varied. Cooking is of doubtful excellence; much good food, which a French cook would make delicious (if not healthful), is made into despicable messes. Wheat, rye and Indian, and Graham bread are all used, and the bread is good. Pies, of every imaginable quality, are almost universally used, not as a substitute for bread, but as supplementary.

Tea and coffee infusions are generally very mild, and there is rarely occasion to regulate their use.

Food varied and in proper proportions. Vegetable-gardens with the farms, and the vegetables well stored. It is doubtful if the modes of cooking are as good as may be. Wheat is chiefly eaten, and the bread is well made. Pastry is not used as a substitute. Tea and coffee not judiciously used.

[A factory and farming town.]

Except among the very poor, the food is sufficiently varied and good in quality. Vegetables are abundant. The frying-pan is used altogether too much in cooking. Wheat and brown bread are both eaten. The Irish use only wheat. The bread of the Irish seems to be good. Among Americans it is often very bad. In most families the coffee is very weak and poor. Tea is used excessively and harmfully.

Food is not sufficiently varied. The poorer class of foreigners live almost entirely on wheat bread. All classes use too much fine flour. Many families

are nourished almost exclusively on salted meats and hot bread or biscuits, improperly cooked. Others err in eating too much fresh meat in hot weather; very few changing their diet with the seasons. But there is improvement in both respects during the past ten years. Too much pastry is consumed. Scarcely a meal is eaten without pies. Tea is used excessively.

[A manufacturing town.]

Food is generally suitable and sufficiently varied. In the sparsely settled portion of the town, too much salted meat is used. Vegetables are plenty and well preserved. Cooking is usually good, but meats and vegetables are often underdone. Bread is not well made, but is varied in kind; it is too often eaten hot. Tea and coffee are seldom detrimental. Pastry is not excessively used, but insoluble compounds of flour, sugar and fat are too often met with.

Food is varied and in good proportions. Vegetables are plenty and are stored in cellars. Cooking is a failure. Mixed varieties of bread are used, and they are well made. Pastry is used more than it should be. Tea and coffee injudiciously used. The habit of eating hastily is productive of more injury than the kind of food eaten. The shoe-business is the chief interest here, and large numbers of both sexes are employed in the "steam factories," and board or live in hired houses, with little idea of a "home." A few, comparatively, work in shops near their own dwellings, and as a general thing this class is better fed and cared for.

Food is not varied sufficiently, nor are the proportions approved; the meats are mostly salt. Vegetables are plenty and well kept. Cooking is good, but could be improved. Wheat bread mostly used, and it is well made and cooked. Pastry is much used, but not as a substitute for bread. Tea and coffee intemperate in amount.

Our people are farmers, and their diet is plain but well varied. Vegetables used and well stored. Cooking satisfactory. Wheat bread the chief; it is well cooked. Very little pastry used. Tea and coffee are used judiciously.

[The six following letters are from farming towns.]

Food varied and in proportion, with the exception that salt pork is in some localities too much eaten. Vegetables raised and well kept. Modes of cooking as good as the average. Wheat bread, well made, in common use. Pastry not used in substitution. Tea and coffee judicious in amount and strength, but not in quality.

Food well varied; too much salt food in summer. Vegetables, plenty and well kept. Modes of cooking "palatable." Wheat bread, generally well made, used, without much pastry.

Food satisfactory in variety and proportion. Vegetables raised and well stored. Modes of cooking approved of. Wheat and mixed breads used; they are well made and cooked, and very little pastry is used. Tea and coffee are used to the detriment of health.

In *most* families in this town the food is sufficiently varied and its different elements are in good proportion. The same half-commendation may be applied to the cooking. Vegetables are abundant and well kept. Wheat bread is in common use. The farmers also use corn and rye.

In a great many families the bread is neither well made nor well cooked, but in the houses of most of the people it is good. Nearly all our people drink either tea or coffee three times a day with their meals,—a thing, by the way, never done by the Turks or Chinese or other Asiatics, who taste it in very small quantities between meals. I meet with many cases of derangement of the digestive and nervous systems which resist all remedial treatment so long as the patients continue the use of either tea or coffee, but which are speedily relieved after abstaining from their use. The Japan and green teas are more injurious than the black teas.

The proportions of meats and vegetables are not what a judicious physician can approve of. Too much salt fish and salt pork. The modes of cooking are generally inferior, and in many cases positively injurious. Wheat is generally used for bread; poorly made and cooked, and eaten hot. Pastry is not used extensively. Tea and coffee are used intemperately in quality and strength.

There is great want of personal cleanliness among the people. Sleeping in small rooms, the system becomes more or less loaded with a poison engendered within itself.

The food is in good variety and proportions. Vegetables are plenty and wholesome. The cooking "may be improved." Wheat is the kind of bread chiefly used; it is indifferently made. Pastry does not take its place. Tea and coffee of inferior quality are in use.

[The following letter is from a physician of large experience, and one well acquainted with the people of Massachusetts, whether living in towns, or in the agricultural, or the maritime districts.]

I give you the subjoined hasty views in reply to the printed interrogatories forwarded me.

1. Is the food in common use among the people conducive to health? Is the food in common use sufficiently varied in kind?

Answer.—In the range of my observations in fishing communities early in my life and late among agricultural people, I do not think the general physical condition of those pursuing the above avocations impaired by the want of variety in the food in common use.

The finest looking men, the most robust and with capacities for great endurance, were the fishermen.

Their food whilst following an occupation so conducive to health was fish, pork, potatoes and hard bread, with fresh meat but rarely. They lacked nothing in virility, their wives were prolific and their children the hardiest in New England. It was then, and I suppose it is now, the custom for invalids from the rural districts suffering from chronic indigestion or incipient phthisis to tempt the sea with these hardy adventurers, and often with the most favorable results.

In the agricultural communities under my observation there is not as much variety in food as there was forty years ago. The quality of it is not so good and the cooking of the same greatly deteriorated.

Our farmers, however, eat more fresh fish than formerly, from improved facilities in transportation, and on the whole I should say, there was no perceptible impairment in the physical condition of those engaged in out-door pursuits, from a lack of variety in the food, but deplorable results from the manner of cooking it.

Many of the children of the poorer classes who pick up what they can in the way of food, are yet hardy and healthy looking, *because they enjoy the light and warmth of the sun and have plenty of pure and wholesome air.*

2. Are the proportions of fresh and salt meats, of vegetables and of the various forms of farinaceous food such as you approve?

Answer.—I should say yes, with the exception of the farinaceous forms of food. There is not sufficient variety in the kind of bread in use in the manufacturing towns and villages, and among the laboring classes engaged in other occupations.

3. Have farms good vegetable-gardens, and the means of storing vegetables so as to keep them in a fresh and wholesome condition?

Answer.—The farmer tilling his land near cities, manufacturing towns and thriving communities, derives most of his income from the sale of milk and the products of his vegetable-garden. The laborers on these farms (mostly unskilled foreigners) are not generally so well fed as the help of the farmers were in the good old times, when they ate at the same table with their employers *and remained with them until their majority.*

I do not think the smaller farmers pay so much attention to vegetable-gardens as formerly, but I think the evil from poor storage of vegetables greatly overestimated.

4. Are the modes of cooking food of all kinds as good as can be employed?

Answer.—Modern civilization, progress so called, tearing away the old-fashioned open kitchen fire-places, where a johnny-cake could be baked on a board, and eaten with sweet butter and served with a rasher of pork (food fit for a king), has produced the same physical deterioration among our people, as the substitution of a hole in the floor for the open fire-places of our forefathers has caused in their minds and morals.

It is dreadful to contemplate the evil results of our modern appliances for warmth and cooking.

5. What kinds of bread are chiefly used—wheat, or corn, or rye or mixed?

Answer.—Good house-wives who have not forgotten their grandmothers, use a sound and salutary discretion, but as a general thing wheat bread is too extensively used.

6. Is bread generally well made and cooked?

Answer.—No.

7. Are any forms of pastry extensively used as substitutes for leavened bread?

Answer.—Too much so for the health of the community.

8. Is the use of tea and coffee judicious in amount and quality, and strength?

Answer.—The moderate use of these beverages when pure and unadulterated is comforting and beneficial to health. Their inordinate use, and particularly when they are substituted for nourishing food and drinks, is a prolific cause of anæmic diseases and neuralgia.

Food varied and in proper proportion. Garden vegetables cultivated and well preserved. The use of vegetables and small fruits has much increased of late years. Cooking is good. Flour bread chiefly used; it is well made. Pastry is used a good deal, but rather supplementary to than as a substitute for leavened bread. Tea and coffee are used judiciously.

"There should be less pastry and more corn bread." Vegetables raised and stored properly. Cooking, good. Mixed breads used, but wheat is the chief; it is well made. Pastry is used, but not as a substitute for bread. Tea and coffee are used temperately.

Food varied, well proportioned and well cooked. Vegetables used and stored properly. "Mixed" bread, well made, in use. No forms of pastry extensively used. Tea and coffee judiciously taken.

The food in common use is not as varied in kind as it ought to be. The farming people live largely on salt pork, salt fish, potatoes and bread. The factory people do better, but their food is too often carelessly prepared. The farmers have kitchen-gardens, which are very often neglected and unproductive. Cellars are ample for storage, but vegetables are not usually cooked well. "Boiled victuals," the old New England preparation of garden vegetables, is very common. Every kind of grain is used for bread, except oats,—and oatmeal is sometimes found among Canadian and Nova Scotia families. Bread is almost never nicely made and baked. I am often obliged to take meals away from home, and it is rather uncommon to find wholesome food of any kind. Pies are much used among American families. Strong tea injures some of our people. Coffee is not much used.

Food varied in kind and proportion. Vegetables well kept. Cooking, satisfactory. Wheat bread, well made, is in general use. Tea and coffee are not used to excess.

[Martha's Vineyard.]

Fish and fowl abundant; meat less common, and fresh meat especially so. All the farms have gardens and good cellars; and vegetables are abundant, but not in sufficient variety. There is too much frying; otherwise the cooking is good. Wheat bread is the staple; it is well made. Corn and rye bread and corn bread are also used. Pies and cakes are the worst features in the diet of this community, and most conducive to indigestion; they are eaten indiscriminately for breakfast, lunch, dinner and supper. Tea is used judiciously and is more common than coffee; cocoa is occasionally used.

I think the food in use here is conducive to health. Half of our population are of foreign birth, and are employed in the mills. In so far as the raw material goes, their food is, on the whole, good in quality, quantity and variety. The cooking is poor, except of bread, which is good. Tea is of fair quality, but is used too strong by the females. Coffee is much adulterated, as bought of the grocers.

[A farming town.]

The food is judiciously varied in quality and proportion, except that salt meat is mostly used in summer instead of fresh. Vegetables are freely used and are stored in cellars. Cooking might be improved. Wheat bread is chiefly used; it is generally made well. Pies are too much eaten. Tea and coffee are used of injudicious strength.

[From a large city.]

Among the poor, the food is insufficiently varied. The modes of cooking are inferior. All kinds of bread are used, and the baking is bad. Pastry is used extensively, but not as a substitute for bread. The quality of tea and coffee is poor; their strength injudicious.

The food is varied in kind and proportion; vegetables are freely raised and well stored. The cooking is satisfactory. Flour bread is chiefly eaten; it is not well made; pastry is not used too much. Tea and coffee are taken judiciously.

Food varied and properly proportioned. Vegetables "the best in the State." Cooking is inferior. Wheat-flour bread, ill cooked and eaten hot. Pastry is used extensively and injuriously. Tea and coffee are used by all, but judiciously.

Food in good variety and properly proportioned. Vegetables well provided for. Modes of cooking satisfactory. Wheat bread chiefly used. Tea and coffee in proper use.

[A market-gardening town.]

Food varied and in good proportion. Town famous for its vegetables; they are stored in barn-cellars and in furrows and very little in kitchen-cellars. Cooking, good. Wheat bread chiefly used, and cooked. Pastry is not used to the exclusion of bread. More corn and rye recommended as breadstuffs. Tea and coffee in general use but not to excess.

[A farming town.]

Food sufficiently varied in kind and in proportion. Vegetables abundant and well stored, Wheat bread, the staple; it is "pretty well" cooked. General modes of cooking might be improved. Meat fried too much. Pastry, made very sweet, is too much used. Tea and coffee used temperately.

[Cape Cod.]

Food varied. Plenty of vegetables. Wheat bread mostly used; it is not well cooked. Cake and pies are extensively used. Tea and coffee are of inferior quality.

[Essex County.]

Fresh meat in general use. The farmers usually have good vegetable-gardens and the means of storing vegetables. The kind of bread used is mostly wheat; the bakers are largely patronized.

[A farming town.]

Food varied and in good proportions. Vegetables in abundant use. Modes of cooking generally satisfactory. Mixed forms of bread are used; and they are well cooked. Pastry is not used exclusively. Tea and coffee in judicious use.

[Cape Ann.]

The use of fresh fish affords a wholesome variety of easily digested and nutritious food. In this respect our people have an advantage over those living away from the sea. Vegetables are extensively cultivated for the markets, and are a source of profit. There is too much frying in fat. Our women understand the cooking of fish in every form. Bread is made from various grains, but the use of wheat bread has much increased of late years. In some families it is well made; in many others too little attention is given to the "rising," and the bread is heavy and sour. It is also eaten too soon after baking. Coffee and tea are largely consumed. Coffee is too often boiled with molasses, and makes a villanous compound.

I believe that a poor diet tends to produce consumption, and have no doubt that this disease is less frequent in this town than formerly, because the mass of the people are better livers. A striking illustration of the influence of this cause is found in the history of a large family, which has perished by consumption since I took up my residence here. Father, mother, seven or eight children, and several grandchildren have been swept away by this disease. Speaking of this family to a rather rough but shrewd neighbor of theirs, and remarking that it was strange they should die in such quick succession, he exclaimed: "Not strange at all. It served him right. He was so stingy that he never allowed himself or his children enough to eat. He brought up his family on slops, and that is the way he got his pay for it." If the inner history of many families were known, a similar judgment might be justly made.

Food not sufficiently varied. Cooking, careless. Wheat the staple for bread; the bread is not well cooked and pastry is too much used. Tea and coffee are not used judiciously.

[A farming town.]

Food in good variety and in proportions favorable to health. Sufficient care in storing vegetables is not taken; the cellars are sometimes damp and promote disease. Cooking, generally good. Wheat, corn and "mixed"

breads are used; no fault found with the cooking. Pastry is not used as a substitute but as a supplement for bread. Tea and coffee are sometimes used too strong, causing sleeplessness.

Food varied and in good proportion, with plenty of good vegetables. Cooking, generally good. Wheat, with a good proportion of corn and rye, in use for bread; the baking is good. Pastry is used in considerable amount. Tea and coffee in good amount but poor quality.

Fresh meat is the exception in daily use. Vegetables are used freely. In cooking, there is too much frying. Flour bread is the common staple, and improvement in its cooking is noticed. Tea and coffee are used judiciously.

Too much pork eaten, and in general too much salt meat and too few vegetables. The cooking, satisfactory. The bread,—wheat; well made. Tea and coffee in general use, the tea too strong.

[Connecticut Valley.]

Too much salt food is used, but a change for the better is evident. More attention is also given to raising and storing vegetables. Too much frying and cooking in fat. Wheat mostly used as the breadstuff; the bread is generally well made. Pastry is not used as a substitute for bread. Tea and coffee in some excess, especially the former.

Too many "condiments." Cellars are damp, and thus ill adapted for storage of vegetables. Cooking as good as the average. Wheat almost the sole staple for bread; it is cooked well. Pastry is not used as a substitute, but as supplementary to bread. Tea and coffee "as good as can be obtained."

Food is varied and in good proportions. Vegetables abundantly raised and well stored. "No better cooks on earth." The bread is varied and beautifully cooked. Pastry is not used as a substitute for bread. Tea and coffee used healthfully.

The food is not sufficiently varied; the vegetable-garden is not attended to. Cooking is of doubtful excellence. Wheat is the common breadstuff. Pastry does not take the place of bread. Tea and coffee are generally used with moderation.

Food is not varied enough, and its proportions should be improved. Vegetables are raised but are not well kept. Modes of cooking inferior, as a general thing. Wheat bread, poorly made, is common. Pastry is not much eaten instead of bread. Tea and coffee, poor in quality.

Pork is too generally used. Good vegetable-gardens. Cooking, inferior; meats are too often fried. Corn and rye mixed, wheat and oatmeal the usual breadstuffs. Bread generally well made, but too often eaten hot. Pastry is too freely used. Tea and coffee not generally abused.

Food is varied here, and in good proportions. The cellars are well adapted to keep the vegetables in good order. The cooking is satisfactory. Wheat bread, generally well made, is the common form. "Artificial" coffee is used without ill effects.

The variety and proportions of food are satisfactory. Vegetables are raised and well kept. Cooking is inferior. Wheat bread is the rule, and it is well made. Tea and coffee are used with moderation.

The food is varied, and the facilities for obtaining it very good; markets are depended upon, and they supply the demand fully. Wheat bread is most used. The cooking is quite well attended to. The use of tea and coffee is not excessive.

The food is sufficiently varied for health, and is properly proportioned. Well-kept vegetables are abundant. Modes of cooking are open to improvement. Bread is chiefly made from wheat, and is well cooked. Tea and coffee are generally used temperately.

The food is used in proper variety and proportions. Some cellars are wet in the spring, but the storing of vegetables is, in the main, well cared for. Cooking is good. Bread made from wheat, and well cooked, is the rule. Pastry not used too much. Tea and coffee taken judiciously.

Food varied and generally in good proportions. Vegetables are raised freely and stored properly. Wheat bread, well made, in common use. Hot pastry too general. Tea and coffee, for the most part, used judiciously.

This community is well supplied with food, as regards variety and quality. Situated as we are, near the salt water, fresh fish are abundant. The surrounding farms furnish a good variety of vegetables. The modes of cooking food should be included in the course of study in the public schools. The bread as furnished by the bakers (wheat bread chiefly), is well made and well cooked. Pastry is not much used. Tea and coffee used judiciously, the former more freely than the latter.

Food in proper variety and proportions. Vegetables abundant and in good condition. The modes of cooking are better than the average. Wheat bread, well made (better than formerly), is the rule. Tea and coffee generally used judiciously.

Food is fairly good. Fresh meats and fish are within the reach of all. No farms of any size exist here; garden vegetables alone are raised.

"Too much salt fish is used, and children should take more milk." Good vegetables are plenty. Cooking is well understood. Wheat bread, well cooked, is very generally used. Pastry is not used as a substitute for bread. Coffee is used impure; neither tea nor coffee used injudiciously otherwise.

Food is varied and well assorted, on the whole. Modes of cooking inferior. Bolted wheat bread is the rule. Pastry very generally used. In mechanics' boarding-houses, pies are eaten at almost every meal; they are as heavy as lead, and take the place of bread to a great extent.

The food in common use is believed to be conducive to health. "Mill-operatives and the poor, as in every other place, are more liable to get too much salt meat, unwholesome stale vegetables, with the poorest of cooking."

[A farming town.]

If people die of consumption, acquired here, it is because they sleep in little, close, impure bedrooms on the ground-floor, never bathe but once a week, at the best, and eat little meat except fried salt pork. The butcher runs through the town once a week, and the baker just as often. What with fried salt pork and heavy brown bread, and poor butter, and bad air, and closed pores, it is only a wonder that they live as long as they do.

Food varied; too much salt meat. Good gardens; storage inferior. Modes of cooking open to criticism; too much frying. Wheat bread, well cooked, is the rule; pastry does not take its place. Tea and coffee judiciously used.

Food well varied; the quantity of fresh meat might be advantageously increased. Good vegetables are plenty. The cooking is generally satisfactory; fresh meat is overdone. Wheat bread or corn bread are universally eaten; well made and well cooked. Pastry is not used to the exclusion of bread. Tea and coffee are generally used; the coffee is a "vile imitation."

The variety and proportions of the food in use are satisfactory. Vegetables are raised and well stored. The cooking is of doubtful excellence. Wheat bread principally eaten; it is well cooked. Pastry not used as a substitute but as a supplement. Tea and coffee usually satisfactory in strength, quality and amount.

[A boot and shoe town.]

The same unvarying round of pies, cake, tough meat poorly cooked, boiled tea and muddy coffee is repeated day by day. Too much salt meat and salt

fish are used, and too little farinaceous food. Indian meal and oatmeal are more used of late, but when in form of pudding are insufficiently boiled. Oatmeal simply boiled in water, with salt, for one hour at the least, then allowed to partially cool, and eaten with milk and sugar or molasses, makes an excellent breakfast dish, and its general use would be beneficial. Few vegetables are raised here and the means of storing them are deficient. As a general rule the modes of cooking are semi-barbarous. Frying is universal. Fresh meats and fish are seldom boiled. Soups are almost unknown, except among the Canadian French. The majority of families in this town eat pie at every meal. Doughnuts and "turnovers" (that is, pastry folded on itself with cooked fruit inside, fried in lard) are also in general use for supper or breakfast. The pies are usually underdone. Pies, doughnuts and cake are extensively used as substitutes for leavened bread; many families also use crackers as a substitute for bread, buying a barrel at a time. A ten-cent loaf of bread sold at the baker's in this town weighs one pound and thirty grains. A ten-cent loaf bought in Boston weighs one pound and a quarter and is of much better quality. Tea is commonly taken with dinner. Both tea and coffee are poorly made, but improvement in this respect is observed of late.

Food is well varied and its proportions are satisfactory. Vegetables are raised and properly stored. The modes of cooking are defective. "Brown bread" among the farmers; wheat bread among the mill-operatives; the baking is good. Pastry is not used as a substitute for bread. Tea and coffee are often taken with injury. The coffee is a "vile compound."

Food varied and in good proportions. Vegetables raised and kept in good order. Cooking is satisfactory. Wheat bread, well made, is the principal form. Unbolted wheat is becoming more common. Pastry is not used as a substitute for bread, but as an adjunct. Tea and coffee are used judiciously

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Food is well varied; and in general, is well assorted. Vegetables are raised in plenty and are well stored.

Food varied and in proper proportions. The cooking is satisfactory. Bread is made of wheat flour and is well made. Pastry is not too much used. The use of tea and coffee is temperate and judicious.

More fresh meat recommended. The cooking is good. Leavened wheat bread is generally used, and it is well made. The tea and coffee are too strong.

[Martha's Vineyard.]

Food is varied and in proper proportions. Vegetables are raised and stored well. The cooking of meats is carried too far and the frying-pan too often takes the place of the gridiron. The bread is made chiefly of wheat, but other materials are considerably used. The bread is well mixed and

well cooked, but it is usually either made with saleratus, or Horsford's Powders, instead of yeast.

Too little meat eaten, especially among mill-operatives, since the prices were so high. Vegetables are plenty and wholesome. Cooking not above reproach. Wheat bread, well made. Tea and coffee are often used too strong; and the amount of nutritious food taken is lessened in consequence. Coffee, as commonly sold, is greatly adulterated.

The food is becoming more varied. Vegetables are more generally raised and the storage of them is good. Cooking of bread is satisfactory. The bread is made of wheat flour more than formerly, but the farmers retain the "rye and Indian" still. Tea and coffee are used judiciously.

Too much salt pork and too little fresh beef eaten. Vegetables and their storage are deficient. Cooking is too hastily done and frying is general. Many farmers suffer from indigestion. Mostly, wheat and corn are used as breadstuffs; the bread, as a rule, is poorly made and indigestible. Pastry is more common than formerly and consists of villanous compounds. Pure teas and coffees scarce ever seen.

Vegetables are abundant. Cooking might be improved. Wheat bread is generally used and it is well made. Pies are eaten too frequently, but not instead of bread. Too much tea is used. Coffee less in use than formerly. Dyspepsia is so common that it seems as if the food must be responsible for it, at least in part.

[A factory town.]

Food varied and well assorted. Vegetables are abundant and wholesome. "The modes of cooking differ with the different nationalities represented here. The Canadians use a large proportion of fresh pork, boiled or fried, with potatoes, onions, pea-soup and bread; the Irish use beef, pork, fish and eggs, with potatoes, cabbage and bread; the Germans are much inclined to beef and soups, with a variety of vegetables and bread; the English stick to mutton and beef, with vegetables and bread; our natives use a greater variety than any other class." Wheat bread, with some corn and rye mixed, usually well made. Pastry is not extensively used as a substitute for bread. Too much tea and coffee are used; the quality is poor and the amount and strength such as to impair digestion and produce disorder of the nervous functions generally.

Pork is used too liberally. Vegetables stored in house-cellars. Frying too common. Wheat bread general, well made and well cooked. Pastry not used. Tea and coffee used, but the correspondent states he has "not been *troubled* with their strength."

Food varied, but too much fresh meat is used in the hot season. Vegetables are obtained from Boston in a poor condition. Frying too common.

Flour bread, poorly cooked, in general use. Pastry is used as a substitute for bread. Tea and coffee are used too strong.

Food is varied and well assorted. Vegetables are unusually good in this town. The cooking is of doubtful excellence. Wheat bread, cooked well, is chiefly used. Pastry is not used as a substitute for bread. Tea and coffee vary much in quality and people are injudicious in the quantity they drink.

There is not sufficient variety in the kinds of food in common use, especially among farmers, and women who do their own work and whose husbands dine in Boston. There is too much salt meat and salt fish, and not enough of fresh vegetables and fruit. There is too much frying.

There is much market gardening and the means of storing vegetables are sufficient. Wheat bread is generally used, made from the finest flour, but I can see a decided increase in the consumption of "mixed" bread. Pies and cakes are too much used, but less than formerly. Many families use tea at every meal, and many hard-worked housekeepers nerve themselves up with strong tea and spoil their appetite for wholesome food as well as ruin their digestion.

I think the relative proportions of different articles of food are better preserved in our farming and semi-farming communities than elsewhere. There are generally plenty of vegetables but they are badly kept in moist, unventilated cellars, whence the odors of decay escape into the rooms above. No one seems to know that a south window may be kept open. Frying meat is still more common than broiling, but the change in this respect is slowly in the right direction. Both wheat and mixed or brown bread are used. There are more people who know how to make "raised bread" than there were twenty years ago, although many mix it with milk. More than half of the flour is mixed with cream of tartar and similar substitutes for yeast. The use of pies is general.

Food is well varied and proportioned. Vegetables are plenty and are kept in good condition. The cooking is inferior; there should be more boiling or broiling. Wheat-bread, well cooked, is in general use. Tea and coffee are used judiciously.

Food is not sufficiently varied or assorted. Vegetables are well preserved, as a rule. The cooking is inferior. Fine wheat is used for bread, to the exclusion of rye and corn. The bread is generally well made. Pastry is too much used, excluding meat rather than bread. Tea and coffee (the latter poor in quality) are in general use.

The food is varied and well assorted. Vegetables are abundant and well preserved. The modes of cooking are probably not the best. Wheat bread, poorly cooked, is in principal use. Pastry is not used as a substitute. The tendency is to drink tea and coffee too strong and in too large quantities.

[Cape Cod.]

Food varied and well assorted. The farms generally have good vegetable-gardens and the means of storage. The modes of cooking have improved within twenty years, but are still open to criticism. Wheat bread, generally well made, is chiefly used; and pastry is not used much. Tea and coffee are used judiciously.

The food in common use is not conducive to health. Among the mechanics, too much pastry is used and too little meat and vegetable diet. The farmers have good vegetable-gardens. In cooking there should be more boiling and roasting, and less frying. Wheat bread and "hot cakes" are in general use. The baking is poor. Hot cakes are eaten for breakfast. Tea and coffee are used judiciously.

The food is not sufficiently varied among the poorer classes; too much salt pork is eaten. The vegetables are raised plentifully, and are well stored as a general thing. Wheat bread is in general use. Pastry is not used as a substitute. Tea is drunk too strong and in too great amount. Coffee is less used than tea.

[The seven following letters are from different physicians in a large inland city.]

Food is well varied and in good proportion, with plenty of vegetables, well stored. Cooking is generally satisfactory, but meats are fried too much. Wheat and corn and rye mixed comprise the breadstuffs. I find the poorest bread in American families. Pastry is not used as a substitute. I think there are large quantities of poor stuff drunk, called tea and coffee. The women use tea excessively, especially the Irish.

Food is varied and in good proportion. Good vegetable-gardens and good storage. Bad cookery prevails. Wheat is almost entirely used, and the bread is well made. Comparatively little *good* tea and coffee is used. A vast amount of *slops* is, however, consumed. That this is a fruitful source of dyspepsia I have no doubt.

Our people are very good livers, and errors in the proportions of diets are seldom recognized. Cooking is pretty good for American cooking. Wheat is almost exclusively used. Bread, of which Indian meal is a principal ingredient, is a very active element in causing dyspepsia, and many such cases have come to me from Northern Rhode Island. Pastry is not used as a substitute for bread. The Irish people, and especially the females, often seem to injure themselves in their nervous systems, and their digestion, by deluging their stomachs with tea and coffee.

I think that too much Indian meal and hot bread are used. Dyspepsia is a very prevalent disease, and dyspeptics cannot certainly use them with impunity. The out-door laborer can digest almost anything. There is too much frying, and the American method of cooking bread is inferior. Wheat

and corn and rye mixed are the breadstuffs. Pastry is not used extensively. Nervous women generally drink too much tea. I think the quality of the coffee and tea used might be greatly improved.

The variety and proportions of food are satisfactory. There are good gardens and good storage for vegetables. The modes of cooking are not the best. Farmers use corn and rye for bread, city people use mostly wheat. The bread is not cooked in the best manner. Pastry is a common substitute among Americans, less with Irish and Germans. Tea and coffee are both often of bad quality, and both are often used too strong, especially among females.

The variety and proportions of food are, as a rule, satisfactory. The raising and storage of vegetables are generally commendable. The modes of cooking might be improved. Wheat bread is in common use, and the bread is well made and well cooked, especially among the Irish. Pastry is not used.

The food is varied and its proportions are approved. The farms have good vegetable-gardens and good storage. The modes of cooking are inferior. Wheat bread is mostly used,—not sufficiently cooked in many families.

[From a farming town.]

The food is sufficiently varied in kind and proportion. The means of storing vegetables are satisfactory with three-fourths of the people. "Meats are too often cooked by frying, whereby the fibre is too much hardened, and hot fat combined with them." Bread is made of "wheat flour, unbolted wheat and mixed corn and rye. It is generally well cooked, but it is not always made in a manner most conducive to health; too much is made with soda and cream of tartar instead of yeast or leaven, and the bread is too often eaten hot. Pastry is extensively used, in the form of pies, and sometimes to the detriment of health. It is often a substitute for meat. A small proportion of the people use tea and coffee of too great strength; but the chief fault is the use of cheap substitutes for coffee, in which there is little or no coffee taste."

[From a farming town.]

There is great irregularity in the variety of food; at some portions of the year there is a good variety of animal and vegetable food. In autumn we generally have fresh meat in variety and abundance, also vegetables and fruits; in winter, people are more restricted, using pork in some form mostly for meat; in spring the change is slight, there being some fresh beef and a mixture of salt meats, tripe and fish; and the same may be said of the summer, except that there are fewer vegetables during the latter part of spring and summer than at any other time. This deficiency is met in part by the use of "greens" of various kinds. Potatoes are in use most of the year. Most farms have very good vegetable-gardens, but the means of storing vegetables are limited to the cellars under the houses, and these are many times small, and generally without any winter ventilation except what

chance may obtain; therefore I do not think the storage is such as to keep vegetables in a fresh and wholesome condition, and certainly, the exhalations from such cellars cannot be conducive to health.

Food is mostly cooked in a tolerable manner. Wheat is probably used as the chief bread-stuff, although nearly every family uses some corn or rye, or the two mixed. I think the bread is generally well made, being fermented with yeast. I do not think pastry is extensively used instead of leavened bread. Tea is used quite extensively in this region, the Japan variety being the favorite. Coffee is but little used comparatively, and it is of poor quality, being roasted and ground,—a vile compound with a strong taste, with but little, if any, of the coffee flavor, and many extol such mixtures of pease, barley, carrots and chicory more than they would a purer article. The strength of the beverages is moderate, and the amount used is not excessive.

[From a factory town.]

The food in common use is sufficiently varied, with the exception that in my opinion too much fine flour is used. The Irish generally make excellent bread, of the best of wheat flour, which is the kind generally used. This is a manufacturing town, and the farmers are few. Leavened bread is the general rule, but in many of the boarding-houses, unleavened bread is used for breakfast. Tea and coffee are universally used; the former is generally very good, the latter, very poor, being ground and largely adulterated. In my opinion, too much swine's flesh is used in an unsalted condition, and it is generally fried, which is very objectionable.

Food is sufficiently varied and in proper proportions. Good vegetable gardens and good storage. Modes of cooking, on the whole, good. Wheat bread in chief use; its cooking might be improved. Pastry is not used as a substitute for bread. Except in the use of Japan tea, coffee and tea are used judiciously.

[From the late Dr. John Dole, of Amherst.]

The food in common use is now sufficiently varied in kind, a marked change for the better having occurred in this matter within the past five years. There has been until lately, an undue proportion of salt food used. "Corned beef" and salt pork have been the chief articles of meat diet among a portion of the farming population, owing partially to want of access to butchers, and partly to want of knowledge as to what was really desirable for thorough nutrition. But of late, physicians have taken pains to advise in this matter, and the people are easily acessible to ideas. I have carefully noticed this point, and have been struck with the change for the better. Many of the farmers have good gardens, and store their vegetables with care. Food is better cooked than formerly. The frying-pan has been in a great measure displaced by the gridiron in the cooking of fresh meat. The use of coal instead of wood, has brought about changes in the character of cooking and of cooking utensils. The old-fashioned oven has been superseded by stoves and ranges, and the change of fuel tends to insure a steadier temperature in baking, roasting, etc.,—on the whole, an improvement. Wheat bread is largely used. The rye bread is of good quality, generally well cooked and nutritious, and is used very commonly among the

farmers, and to some extent among all classes. I have not known of any form of pastry used as a substitute for leavened bread. Tea and coffee are used quite commonly. Coffee, or some substitute for it, such as rye, chicory or beans, used almost universally once a day. Tea is more largely used,—generally black or mixed; the stronger kinds of green tea used occasionally. I should say the excessive use of tea is more common than that of coffee in this community.

This matter of food and cooking has been one of constant observation with me, and in general terms I can affirm a decided improvement in this community. I am daily impressed with the fact of the growing care with which I can nourish my patients, especially those in typhoid and analogous conditions, and this in great measure is the result of a better appreciation on the part of the people of the need of preparing good food,—broths, soups, etc.

Too much salt meat, especially salt pork, is used in this sparsely settled region; with this exception, the proportions of food are satisfactory. The farms have good vegetable gardens and good means of storage. The modes of cooking are not as good as can be employed. Wheat bread is principally used; corn and rye occasionally. Too much hot biscuit is used. Sour milk bread takes the place of leavened bread. The tea and coffee are judiciously taken in quantity, quality and strength.

[From a tannery town.]

The food is thought to be sufficiently varied, and its proportions are satisfactory; the butcher's meat sold to the working classes is judged to be of inferior quality. The vegetable gardens and the storage for vegetables are good. Wheat bread is most used. Many families use hot biscuit in the morning. Brown bread, hot, is much used at breakfast, and cold for dinner. The bread is not generally well made nor are the modes of cooking as a whole satisfactory. I have come to regard the making of good, wholesome bread as among the lost arts. I believe that fully one-half of American families do not know what *good* bread is, never having seen any. If it be judicious to use tea and coffee at all, those in use here are judicious in amount, quality and strength.

The food in common use is sufficiently varied. Except among the poorer classes, who have an insufficient supply of fresh meat and milk, the proportions of the food are satisfactory. The farms have very good vegetable gardens and means of storage. Wheat bread, and occasionally corn and rye, are used; generally the bread is well made and well cooked. Some families use almost exclusively cream-of-tartar bread, warm or cold. Pastry is not thought to be used as a substitute for bread. The tea and coffee used have not produced any perceptible ill effects.

[From a farming town.]

The food in common use is not sufficiently varied. In most families there is a monotonous routine. From November to April, salt pork and potatoes constitute a large part of the diet of the poorer class. The farms have good

vegetable gardens and good means of storage. Wheat flour bread is used almost exclusively, especially by the Irish; made with cream of tartar. The old-fashioned brown bread is becoming obsolete. Graham flour is but little used; hence the increased amount of constipation and piles. The bread is generally well made and well cooked; but too much of it is eaten in the form of hot biscuit. Pastry is not thought to be used as a substitute for bread. The quantity and strength of tea and coffee are excessive.

The people in this vicinity live pretty well, both as to quantity and quality of food. The proportions of food are as a rule satisfactory; and vegetables are raised abundantly and are well kept. Cooking is not generally what it should be, but is not particularly objectionable. Wheat bread chiefly used; it is well made and well cooked. Pies of all kinds are extensively used as substitutes for bread. Tea is often used to an injurious excess.

In the proportions of food, vegetables are deficient, although most of the farms have good gardens and means of storage. Fresh meats are too often fried. The foreigners (French and Irish) always use wheat flour bread. The natives use wheat flour and mixed. The bread is not well made. The quality of the tea and coffee is generally poor.

[The following letter is from an eminent physician of Boston, who has had every opportunity to become acquainted with the class of patients he describes as suffering from imperfect nourishment.]

I am glad to learn that the State Board of Health have taken up the important matter of the Diet of the People, for I am sure that very great ignorance prevails on the subject. I wish particularly to call your attention to a large class of working people, many of whom are doing their work, as I believe, on very insufficient sustenance,—I mean sewing-women. During my long service as physician to out-patients at the Massachusetts General Hospital, I was very strongly impressed by this conviction. Large numbers of this class,—certainly some hundreds,—consulted me for a train of symptoms which seemed to me very largely due te the simple fact that they did not eat enough substantial food. I could almost tell on the entrance of such a patient what her complaint would be. Let me imagine an interview with such an one, the type of very many which I have had. Enter a well-dressed, highly-respectable looking young woman, without a trace of poverty or privation in her apparel, thin and pallid probably, with a somewhat downcast countenance. In reply to the first inquiry as to her symptoms, the kid-gloved hand is raised to the left breast with a sigh, and "Doctor, I've got a terrible pain in my left side, and think I have disease of the heart." "Why do you think that?" I ask. "Because (with another long sigh), I cannot go up-stairs without my heart beating so that it takes a long time for me to recover my breath." Then follows a long list of symptoms, all more or less connected with great general debility. On further inquiry I learn that this patient works in some one of the large ready-made clothing establishments north of Summer Street, or perhaps in some one of the fashionable millinery stores of that vicinity. Her residence is at South Boston or in the

neighborhood of Dover Street, or south of it,—perhaps at Somerville or Charlestown,—from one to three miles from the scene of her daily labors. As a consequence she is unable to return home for dinner, and remains at her working room all day. She is obliged to rise very early in the morning in order to reach it at the commencement of working hours. As a matter of economy she usually walks to her shop and back, even when her homeward path is weary with the day's labors. Such a person, with the symptoms above described, on being asked as to her appetite, will say, "Oh, yes, I have a very good appetite." "Well, what do you call a good appetite? What did you eat for breakfast, for instance?" "Well, I ate a slice—perhaps two—of bread and butter, and drank a cup of tea." "Do you go home to dinner?" "No, the distance is too great." "What do you eat for dinner?" "Well, I take with me from home some bread and butter, and a piece of cake or pie, and I have the privilege of warming my tea at the stove in the working room," or perhaps of "making some fresh." "Then you take tea with your dinner, do you?" "Oh, yes; I couldn't get along without that." "How much do you take?" "One or two cups." "Strong?" With a laugh, "Yes; I don't like weak tea." "What do you take for supper when you get home?" "Bread and butter and tea." "Don't you get any meat at that time?" "Not often,—living in a boarding-house, it is very inconvenient to have things saved for you from dinner." The conclusion is, that only about once a week does she get a good substantial meat dinner,—on Sunday; for the rest of the time she is kept up to her work by the stimulus of strong tea. I have often heard such persons, when told that they have no organic disease of the heart, and that the first step towards an improvement in their physical condition must be the abandonment of the use of tea, at once exclaim something like this: "Oh, Doctor, I can't do that; tea is my life; I can't do without it!" This tells the whole story. The amount of food taken is entirely inadequate to the amount of work done, and strong tea, by its temporary stimulus, supplies the place of food, until the train of nervous symptoms, which are the natural result, at last drives them to the doctor. This is not the place to discuss the medical treatment of such cases; it is sufficient to say that their improvement is generally rapid under the use of tonics, with a proper supply of nourishing food, and the disuse of tea.

I cannot forego the opportunity to suggest a plan which, it seems to me, would do much to prevent the occurrence of such cases as I have been describing. It is the organization, by benevolent persons, of dining-clubs, for the benefit of sewing and shop women who cannot go to their homes for dinner. If one or more comfortable dining-rooms could be opened by persons of means, in the vicinity of the business part of the city, and a good dinner provided daily for working-women, which they could obtain at cost, I think a great public good would be the result. These could be made as private as might be desired. They might be managed, for instance, as the Thayer Club at Harvard University is, the great point being, through the instrumentality of benevolent people, to provide a dining-room free from the cost of rent to those for whom it is designed, so that the expense of a good, substantial dinner may be reduced to a minimum. I think many a side-ache and heart-ache would thus be spared to a very worthy class of people.

From these letters a fair general view is obtained of the food in common use in Massachusetts. It is not the same in all places, even among corresponding classes. Cape Cod and

Cape Ann differ in this respect from Berkshire and Hampshire. The farmers do not have the same food as the people of the large towns. The Irish, the French Canadians and the Germans have their peculiarities in diet as in other respects, which, however, are soon modified by living among us. The richer and more luxurious class of our citizens, in town and country, have their own style of living. But making all these allowances, it is still apparent that among the million and a half of people in Massachusetts, a great majority have a selection of food which may be regarded in a general way, since it has a distinctive character.

That this is so will be recognized by all who remember whether they are in the habit of eating fish-balls and rye-and-indian bread for breakfast, and baked salt pork and beans, seasoned with pepper and vinegar, for dinner, every Sunday. These dishes are found only here, where they originated, or where New Englanders have carried them.

It is not flattering to our pride to read some of the preceding testimony. But it is consistent with the truest loyalty to our State to examine the question to which it refers, whatever may be the verdict. There are always plenty of people to tell us how intelligent we are, to contrast our institutions with those of other lands to our own great advantage, and to make us feel that we lead the advance in the march of civilization. We hope that this is all true,—but if it should prove that there are great defects in our social system, the sooner we know them the better. No improvement will come until the people are convinced that it is needed.

Bread.

The quality of bread in any nation, community or family is a pretty good measure of its civilization. No one can entirely dispense with it. Good or bad, in some form it must be had. So it is, and has been from the earliest records of our race, and so it will doubtless continue.

Leavened or fermented bread is as old as the time of Moses, and its value has been fairly tested. There are those in these latter days who would have us believe that the leaven plays no useful part, except by the liberation of fixed air to distend the mass, and that this process may be imitated by the use of

various chemicals. A vast experience contradicts them. Whatever be the precise action of the leaven, it transforms the grain by partial decomposition of its original elements, and leaves as its resultant what all men in all ages have approved. The modern substitutes leave resultants which impair the flavor, diminish the nutritive property, and break the staff of life.

Unleavened bread, made by mixing the various grains with water and salt, and baking (usually in thin sheets) is quite another thing, and a form of nutriment with which we have no fault to find, unless it supplants, in the form of crackers, the more legitimate article.

Is the art of making good, honest, leavened, bible bread lost in Massachusetts, as some of our friends declare? One may go up and down the State, as the writer has done, stopping at hotels, railroad restaurants and private houses, and be almost ready to believe it. For a single specimen of bread made with flour, water, leaven or yeast and salt, sufficient kneading and judicious baking, one will meet with fifty at least in which these requirements have not been met. Baker's bread is almost universally mixed with some extraneous substances, alum and carbonate of ammonia being most employed. Bread hastily made in families is mixed in a variety of ways with carbonates of soda or potash combined with phosphate of lime, with cream of tartar, or with sour milk, and is generally imperfectly cooked. Instead of honest bread and sweet butter, their places are supplied in thousands of families by some of the poor substitutes for bread to which we have referred and by butter carelessly made and wanting those savory and nutritious qualities it ought to have, and which are so valuable to young and old.

Very often the elements of wheat and fat* which the body demands are furnished in underdone pastry, made from flour and hog's lard. If our readers think this representation incorrect let them look at the food supplied at railroad restaurants, or other and similar establishments, whose business it is to meet in this respect the demands of the people. Pies and sweet cakes, with coffee, tea and milk are the staple articles in

* A wise and witty Boston clergyman of the last generation used to say, "Bread is the staff of life, but bread and butter is a gold-headed cane."

such places. Baked beans and salt pork can often be had, but very rarely good bread, good butter, or good meat. The first legitimate effect of such constant food as this with people of average condition is indigestion or dyspepsia; the second, is all that train of ailments caused by imperfect nutrition.

As an example of good bread we would mention that which is always to be had at the restaurant of Parker's Hotel in Boston. It is not better than is found on the continent of Europe on all the great lines of travel, and in common use by millions of people in Germany and France; but with us it is a rare example of what bread may be. It is made from a mixture of flour such as is generally sold in our markets, water, salt, and yeast,—and nothing else. The yeast is made from malt, potatoes and hops. The dough is kneaded for from one and a half to two hours, and is then thoroughly baked.*

Any family can have as good bread who will take pains to make it in this way. It involves skill and judgment, in which qualities our housekeepers are surely not deficient. The materials are simple and not expensive. The value of time and labor required for kneading are the only real difficulties, and these we would not undervalue; they are in many families very serious, and not easily overcome. But we can see no reason why in any town or village families may not furnish themselves with good bread by means of coöperative associations, without increasing the present cost of this first essential of wholesome nutrition.

If good bread and carefully made butter were always to be had, the consumption of pies, fried doughnuts, sweet cakes, and such meretricious substitutes would diminish; and as surely dyspepsia with its attendant ills would become less frequent among persons of all ages.

Variety in Food.

The expenditures of the body, whether in heat-making or tissue-making, or thought-making, may be theoretically met

*This information was got from Mr. Mills, and the baker of the restaurant. The materials are mixed in large masses, and therefore the time required for kneading by hand is the greater. It is in vain, however, to expect good bread without long-continued and laborious kneading.

by a fixed diet, but practically they cannot be. Experience has proved to every observing person that, for some reason unknown to science, variety is essential to health after reaching the age when we are free to choose our food. Nature provides milk for the babe, and it is not only sufficient for, but essential to its complete development. But the perpetual recurrence of the same kinds of food, even though their number be considerable, becomes in all subsequent periods of life not only wearisome, but positively injurious. One of the advantages of what is generally known as a "change of air and scene" depends, without doubt, on the concomitant change of diet. Seamen feel this restriction of food on long voyages, and their excesses when ashore may be largely due to this cause.

Our soldiers during the late war, restricted for long periods to the army ration, gratified this longing for a change by every device in their power. Inmates of prisons, poor-houses, and even (we regret to say) hospitals, often loathe their food, and are consequently imperfectly nourished, simply because it lacks variety. Visitors go to these establishments and taste the food, and very likely find it better than they get at home, and wonder why it is complained of. But if they were compelled to eat it every day, in the same inevitable round, the same distaste would follow.

Our correspondence shows that the food of great numbers of our people lacks variety. This is due to many causes, and among them are to be reckoned very prominently, poverty, and the difficulty of buying fresh provisions in places remote from markets. Salt pork, salt fish, and potatoes, with pies and poor bread, or its substitutes made from flour or rye and Indian meal, and Japan tea, are the staples of food in thousands of families during our long winters. But there are others, and they form a very numerous class, whose nutriment is deficient simply because they do not know how needful it is to change it from time to time. It is within the power of every one living in the country to use a great variety of fresh vegetables. The climate favors their production, and but little care is required to keep them in good condition. The edible roots, as turnips, carrots, onions and beets, are as well worth preservation as the omnipresent

potato. Each contains elements of nutrition peculiar to itself, and can add new value to the stronger foods. The same may be said of cabbages, now so extensively used by the Irish in Massachusetts. All these vegetables need thorough boiling, and more than they generally get.

The acid fruits and vegetables, as apples, tomatoes, and rhubarb stalks, need no commendation. They seem to meet an urgent want in the diet of our people; and this want is apparently identical with that which has led to such enormous use of vinegar and pickles, in conjunction with the coarse fat of the pig, which, in the form of lard, enters into almost every preparation of food. Wherever hog's lard and fat salt pork are freely used, there will also be found pickles or vinegar.

The mildly acid tomato, unknown here till within half a century, is now most extensively used. Rhubarb stalks in their season, enjoy an almost equal popularity. Apples, now as always, are to be found in nearly every house. And may the use of each of these valuable forms of food never grow less.

The demand for acids in conjunction with the coarse fats is unexplained by science;—and this illustrates several things. First, the enormous complexity of the operations of nature's laboratory in the process of digestion; second, the unfailing guide which instinct gives us in the choice of the elements of our food, when the body is in a state of health; third, the inexpediency of regulating our diet by theoretical considerations.

The frying of meat is most unprofitable for the eater, however convenient it may be for the cook. It robs the meat of its juices and hardens its texture. The extreme heat of the fat not only burns the outer layers of the meat, so as to injure their value for nutritive purposes, but also changes the chemical condition of the fatty acids; giving rise to products which obstruct the breathing and cause tingling of the nose and eyes of the cook, and which are more or less harmful to the eater. The peculiar flavor of the meat is in a great measure lost by frying, and for it is substituted the flavor of the fat in which it is cooked. This fat permeates the fibres of the meat in such a way as to render them less

soluble in the watery fluids of the mouth and stomach, and thus causes difficult digestion.

It is to be feared that our cooks have a fatal facility in the use of the frying-pan. It is the rudest mode of preparing meat, and so inferior to every other in its results, that we may reasonably hope that the improvement in this respect which our correspondents observe will continue. Broiling on a gridiron over a quick fire costs a little more time and trouble, and very likely fuel also, but by this process the juices of the meat are sealed up (to a certain extent), instead of being evaporated, and the nutritive value thereby much increased. The superiority both of flavor and digestibility which broiled meat possesses are perfectly well known. The general substitution of the gridiron for the frying-pan in the hasty cooking of meats, would be most advantageous to health.

Baked beans and salt pork furnish the chief nutriment of at least two-thirds of the people of this State above the age of infancy, for one day of every week. Experience proves that this is a very nutritious food, strong enough to sustain a man under severe labor; and chemical analysis shows that it is rich in the elements which go to make up the strength of the body.

We have no fault to find with this food when sufficiently cooked (as it generally is in Massachusetts), provided it is eaten by persons in health; but a large minority of people of all ages cannot digest it with comfort, and to others it is certainly injurious. It is a serious deprivation to a numerous class to find their supplies of other kinds of meat than salt pork cut off for one, and very often two days of the week, and this is especially the case when good bread and butter are not to be had. The alternative for beans and pork is too often only heavy, sodden, and equally indigestible pie.

That pork and beans are productive of illness in a certain proportion of persons in average health, we feel well assured, from watching the sick-list in a Massachusetts regiment during the late war.

Pastry and Cakes.

Our correspondents nearly all agree in saying or implying that the consumption of these articles is great. It is indeed

enormous, and constitutes the most marked difference between the diet of the people of New England and that of any other people on earth.

In so far as pies are used as staples, or what the French call "pièces de resistance," and not as additions to more substantial food, they take the place which is in other countries occupied by either bread or meat; we incline to believe it is the former; most of our correspondents think the latter. It makes but little difference. The pies made of chopped meat supply in a certain way two great wants of the body; those made of fruit supply others. But both supplement the food made from the cereal grains, whether wheat, corn or rye.

Pies are eaten twice a day by most people in Massachusetts above the age of five, and if a lunch is called for it is generally pie and nothing else. Country bakers often distribute more pies than they do loaves of bread. On the diet list of factory boarding-houses pies occupy the most prominent and constant place. Pies are the most constantly recurring form of food to the traveller throughout the State.

The average Massachusetts pie (used as a staple of nutrition, and not as an addition to a dinner of meat or fish with bread), is made from flour, and water, and salt, mixed and rolled with "shortening," which consists of the cheapest fat to be found, to which is often added carbonate of soda, or some other of the powders which liberate carbonic acid.

The fat is generally hog's lard, but butter of the lowest grades can often be bought at about the same price, and is either used instead, or is mixed with lard. The cheapest and most inferior butter * which is sold, (so bad that it can hardly be eaten with bread) is thus used for pastry and for cake, in prodigious amounts.

The paste prepared in this way is made to enclose, First, chopped meat seasoned with hog's fat and various spices. The meat, like the butter, is usually of the poorest kind, and such as could be eaten in no other form except sausage. The spices cover the taste of the meat, and whether it be beef, mutton, pork, or veal, no one can tell, or form the least judgment of its fitness for food. Second, apple, peach, huckleberry, and similar small fruits. Third, squash. Fourth, custard.

* Butter in which the fatty acids are freely developed.

We intended to say as little as possible about the physiology of digestion, but the fact that pastry is ill borne by those of feeble stomach is so well recognized that an explanation of the reason may be allowed. All forms of food containing nitrogen (including the gluten of flour) are digested in the stomach. Oils and fats of every kind pass unchanged through the stomach and are digested lower down in the alimentary canal. The close incorporation of the gluten with the fat in the process of rolling pastry (needful to make it light by enclosing the materials which will distend it when heat is applied) renders the action of the gastric juice upon the mass exceedingly difficult. It must, so to speak, pick out from this close union the parts which it is fitted to reduce to a form ready for absorption, and let the remainder pass on.

Badly made new bread, by forming a pasty mass, is also difficult of digestion to many persons, as a similar * discrimination must be made by the stomach between the glutinous and the starchy elements of which it is composed. But new bread when well made and cooked is not open to this objection. The French are the best bread-makers in the world, and eat their bread when freshly made.

Time Devoted to Meals.

The usual or average time occupied in the process of taking food by the people of this State we think does not exceed from twelve to fifteen minutes for each meal.† Such haste is injurious to health for many reasons, to some of which we will refer.

Eating in this manner we do not know when we have had

* The same difficulty in disentangling the elements of which food is made up is observed in the case of oily nuts. The digestive apparatus would have no trouble in disposing of the oil, or the starch, or the vegetable albumen, if they were simply mixed together; but in the natural form of the nut the union is so close as to make the task of digestion an ungrateful one with many persons.

† This opinion will be disputed by many readers. but it is founded on careful inquiry and observation. The operatives in boot and shoe shops, cotton and woollen mills and other industrial establishments, make up a very large proportion of our adult population, and as a class they do not remain at the table more than ten minutes for each meal. Those engaged in active, engrossing business and trade throughout the State, allow themselves but little more time. Out of door laborers, and farmers, with their families, are in less haste. The class who remain a long time at the table are (comparatively) few in number.

enough, and are in danger of taking more than the stomach can properly dispose of.

The appetite for food is only gradually appeased. What hunger really is, or how it makes itself felt, it would, we think, puzzle any one accurately to define, but if we eat slowly, time is given for the system to become aware of the progress of the supply and also of its fitness to remedy the want, and presently there succeeds a feeling of satisfaction, which is nature's signal for ceasing to eat. Deliberation in this constantly recurring pleasure gives opportunity also for conversation, and that light occupation of the mind which greatly assists digestion.

This process of digestion begins in the mouth, with the action of the teeth, and through excitement of the salivary glands by the presence of food. Unless saliva is abundantly mingled with food the first act of digestion is obstructed, and nature's plan is changed. This fluid not only lubricates, but acts chemically* in the mouth, if a reasonable time be given it, upon all the starchy elements which make up the great bulk of what we eat.

Eating in haste a great deal of air is swallowed. Air is to a certain extent always entangled in the saliva and assists digestion, but when the "wads" of food (if the expression may be allowed) succeed each other very rapidly, they seem to act like pistons in the tube (the œsophagus) leading from the back of the throat, and drive before and between them into the stomach such amounts of air as distend that organ and impede its functions.

Nature tries to correct this evil by eructations of wind from the stomach immediately after the meal is thus swallowed, but enough remains to become a source of needless disturbance to the whole digestive apparatus.

Another effect of eating in this way is that the masses of food, imperfectly mixed with saliva, become impacted in the œsophagus, checking its muscular action which is obviously intended to propel only one at a time. This embarrassment

* All starch is converted into sugar before it can be absorbed for the body's use. The chief agent in this conversion is the pancreas, whose secretion is mingled with the food after it has passed the stomach, but the salivary glands begin the process, and very actively.

is overcome by taking, at one gulp, as much fluid as the mouth will hold, thus distending the elastic tube and washing the obstructed food into the stomach. All this is surely unnatural and can hardly fail to work mischief in the course of years.

Dyspepsia is too common a complaint among our people to warrant the overlooking such things, which may seem to many persons to be trivial and unimportant.

Tea and Coffee.

The appetite for stimulants of the nervous system, which in some form is met with wherever man exists, finds its gratification to a very large extent in Massachusetts in the use of coffee and tea.

The quality of both these articles in common use is certainly poor. Our report of last year showed that most of the coffee sold in pound packages is largely adulterated with articles in themselves harmless but which greatly diminish its legitimate effect.

Tea does not fail from this cause. It is strong enough. The difficulty lies in its possession of the nerve-stimulating property in an extreme degree. The kinds in most common use by the people are Oolong, Japan tea and Hyson. Souchong (or English breakfast tea) is increasing in use.

Almost everybody drinks coffee at breakfast and tea at supper. A great majority of the people also drink tea at dinner. Among women, tea is also in common use at other times. The overworked and underfed (or imperfectly nourished) sewing-woman, or factory-hand, or housewife, finds comfort and temporary relief from exhaustion by the stimulus of tea at any time.

Both coffee and tea have properties which are universally recognized as valuable. Without being nutritive (except in an infinitesimal degree) they sustain nutrition by limiting the body's waste, and by promoting the absorption of real food. Without being capable of directly forming the tissues of which we are made up, they make these tissues do extra duty by preventing their absorption and removal. They belong to the class of supplementary foods, and, by common consent, rank among the necessaries of life. But like many other

good things they are liable to abuse. Their healthfulness depends on the amounts taken, and the times when taken. They enliven and inspirit the wearied body, and they make nutritious food go farther. But the nerve-stimulation may be carried to intoxication, and the substitution of supplementary for real food may starve the user. An illustration of the first effect may be found in the third report of this Board, page 129, and the second is explained by examples in the letter which we publish from one of the physicians of the Massachusetts General Hospital.

Our correspondence will be found to make very frequent reference to such abuses of tea and coffee. Tea made by pouring boiling water on the leaves, and drinking the fresh infusion, is a very different thing from tea made by long stewing on the fire. In the one case the aromatic qualities predominate, while in the other the aroma is boiled away, and there remains a concentrated decoction of the *thein* and the astringent matters with which it is combined. Such tea is intoxicating, and taken in considerable amounts, and without food, will produce a condition of body resembling delirium-tremens, and a fretful perversion of temper productive of domestic unhappiness, or even crime. In a less degree the same cause of nervous disturbance is often seen in the over-worked and underfed women employed in great cities, as described by our correspondent in Boston. If instead of relying so exclusively upon the cup which is said (incorrectly as we believe) to "cheer but not inebriate," they would substitute for it at night, when the day's work is over, a cup of beef-tea, they would find it to be a cup which both cheers and nourishes.* This change would be followed by refreshing sleep and improved daily strength. There are many extracts of meat now sold at such prices that this substitution may be made, not for the same money indeed, but at

* We have made the following estimate of the comparative cost to a working-woman of tea, and beef-tea made from the Leibig Extract. Tea being ninety cents a pound, sugar thirteen cents a pound, milk ten cents a quart, and Leibig Extract of meat sixty cents for a jar holding two ounces. Twelve ounces of infusion of common tea (two good sized cups), with milk and sugar, would cost two cents; six ounces of infusion of meat extract would cost four cents. Fuel the same in either case. The above is submitted for the benefit of those who cannot use common tea with moderation, or of those whose nervous systems are disturbed by its use.

an increased cost which is worth paying by a woman whose subsistence depends on the maintenance of health and strength. We will anticipate objections to this recommendation by saying that these "extracts" are not to be compared for a moment to meat itself, and are inferior to freshly made beef-tea. But when it is contended, that they hold no albuminous matter, and are *therefore not nutritious*, we must say that experience in their use proves the contrary. The deficiency of an important element of meat may be supplied, if found needful, by adding the white of an egg after the beef-tea is cool enough to prevent coagulation. The extracts of meat have the very great advantages of cheapness and convenience for use when wanted.

Excessive Use of Water.

Every one must have observed the difference in the requirements of individuals in the use of drinking-water. There are those who drink only at meals, and others who drink throughout the day, at short intervals, in both summer and winter. This depends, no doubt, in a great degree upon differences in temperaments, of skin, and of food, but it is also very much a matter of habit. In our manufactories of all kinds, water (very often iced) is placed within easy reach of every person, male or female, and the effect of this constant invitation is seen in the drinking of what physicians must regard as unreasonable amounts. The food is thereby diluted, and the stomach is oftentimes chilled below the temperature of the blood, and by repeated draughts, may be kept in this condition. The process of digestion is in this way seriously interfered with. A certain amount (70 to 100 ounces) of water is required daily for the nutrition of an average adult; but of this total requirement twenty to thirty ounces are contained in the so-called solid food, leaving about sixty ounces to be supplied in some form of liquid, as tea, coffee, and water. If this amount is greatly exceeded, it forces additional and needless work on the organs of excretion.

We are inclined to believe from what we have seen that young persons employed in our factories very often drink double the amount of water which the body requires, from

mere thoughtlessness, and this habit once established, is likely to continue through life.

Cost of Labor as Influencing Food.

Every one familiar with life in New England will confirm the truth of the statement that the effort to escape the wear and tear of domestic service has greatly modified the food of the people. Our housewives are overworked; they have a great deal to do, and but few hands to help them. In the families of farmers and mechanics, in factory boarding-houses, wherever food is prepared for the working-classes, there is the same constant strain upon nerve and muscle. Indeed, every class among us feels the difficulty of securing domestic service. The rate of wages has risen with everything else, until now it is impossible to hire a woman to cook or attend to any other of the duties of housekeeping for less than three to four dollars a week, with board.

Home-life is discouraged, and people take refuge in hotels and boarding-houses in order that by association their care and trouble may be diminished.

This cost of labor has influenced in a great degree the various kinds of food in common use, and the modes of preparing them. Whatever can be made in one day and kept for use in several succeeding days is preferred. The quickest way to cook fresh meat is to put it in the frying-pan. The laborious kneading of fermented bread is dispensed with, and its substitutes are prepared by the hasty stirring-in of chemical powders.

The traditions of honest bread are not lost to the present generation, but there is too often no one to give the time and labor necessary to make it.

This extreme difficulty of doing the needful work of the household "short-handed" is the direct cause of much apparent carelessness in the preparation of food. And the remedy for this difficulty is not obvious. There is a continual removal of women from home-life to do the work of factories. There is a constantly increasing pressure of population in the towns at the expense of the country, and great activity of every form of manufacturing industry in which young women readily find employment. There are those also who say that the

daughters of our hard-worked housekeepers who stay at home do not help their mothers as they should do; and if this is so, the causes are to be looked for in errors of our social system not easily reached or corrected.

No improvements in the manner of preparing food for daily use stand the least chance of adoption in Massachusetts unless they are labor-saving. The teachings of Professor Blot will never avail with us. We need not only to know how to make nice and palatable and wholesome dishes, but how to make them with the least possible expenditure of labor and of time.

This labor-saving principle must be the basis of all amendments, whether as regards fuel, cooking-utensils, coöperative associations, or whatever direction they may take. Whoever can show us how to produce, with the same materials of food, better results with diminished labor, will have done invaluable service; and no one need fear that their efforts, if successful in doing this, will be unappreciated. Never was a people before seen on the earth so ready to welcome improvements of every kind, and even in this province of dietetics, where conservatism is most unrelenting with most nations, real improvements would be well received.

The inventive faculty, so active in other directions, has never made much progress in turning to the best account the abundant food which we have. Its preparation is too often regarded as unmitigated drudgery, and not as a department of art whose cultivation may make our lives more healthy, useful and happy. A great deal of excellent food is wasted in our kitchens. Good flour is turned into various forms of cake which makes a show of variety on the table, but much of it, becoming dry or mouldy, is finally cast away.

Bread in various forms may also be seen in very considerable amounts in the refuse which goes to the pigpens; and bones with adherent meat capable of making excellent soups, take the same unprofitable direction. But the cooks are not alone to be blamed for these short-comings. Eating and drinking are not appreciated. The average Massachusetts man or woman, having a hard battle with life, engrossed with bodily or mental toil, has never seemed to regard food except as fuel for the human furnace; demanding only as good muscle or brain-making fuel as can be got, to be taken in at

regular intervals, and at any rate to be despatched with as little delay as possible.

This neglect of what seems to have been designed not only for our bodily but mental refreshment, coincides with our indifference in the past to Art in every form, painting, sculpture, architecture and music.

This great deficiency in what is needed to make our lives harmonious and complete is not to continue always. There are signs of improvement in all directions. Already we seem to be advancing rapidly in an appreciation of some of these refinements of life, and others will surely follow. There are special difficulties, to which we have referred, in the improvement of food and its preparations, which will make progress slow in this direction, but it will surely come. When bread, the staff of life in all countries, is found to be as good in Massachusetts as in Europe, it will be a sign that the point at which we should aim has been reached.

A REPORT

ON

THE ADULTERATION OF MILK.

BY

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ASSISTED BY

PROFESSOR JAMES F. BABCOCK.

THE ADULTERATION OF MILK.

The very great extent to which the adulteration of milk is avowedly practised in our large cities is becoming more and more a subject of general and just complaint. Although sixteen years have now elapsed since the necessity of legislative interference was recognized in this State, and statutes were framed ostensibly for the purpose of exercising, or inducing the local authorities to exercise, a supervision over the sale of this article, there exist strong reasons for believing that these measures have been to a great degree inefficient or inoperative; that they fail to afford to the public that protection from imposition which they are supposed to offer; that although they sometimes bring to light the more gross and flagrant cases of sophistication, they fail to strike at the great mass of petty offenders, whose adulterations, from the fact that they are carried on more ingeniously and systematically, present more formidable obstacles in the way of detection.

And why are the laws that have been framed inefficient? The solution of this question is to be found in a variety of circumstances connected partly with defects, or deficiencies, in the statutes themselves, and partly with the apathy and indifference which prevails on the part of the public, who fail to recognize the real character or magnitude of the evil. It may be laid down as a general principle, that no offence will, in the estimation of the public, be regarded as a very heinous one, which is not visited with some pretty severe penalty; for it is indeed difficult to regard any misdemeanor as very serious, if it be leniently dealt with, or tacitly allowed, by the existing authorities. The skimming and watering of milk—the darkest feature of which is the increase in the rate of infant mortality thereby caused—should be stigmatized as a grave crime; and the offender, when dragged to light, should be subjected to to some severer penalty than a paltry fine. Once let it be

understood that the perpetrator when detected shall be subjected to some ignominious punishment proportionate to the offence,—shall be, for instance, imprisoned in the house of correction,—in that case a different moral standard will at once be created, and what is now considered as a trivial misdemeanor, will henceforth take rank among the unpermissible as well as forbidden offences.

Again, the law is rendered inoperative by the presence of the mischievous and erroneous idea, that a very great variation exists in the quality of pure milk; and hence, unless a suspected sample is proved to fall *very far* below the normal standard, it is not easy to convince the juryman that beyond all doubt adulteration has been practised. At other times, when the chemist affirms upon oath that the specimen in question has been adulterated with twenty per cent. of water, the correctness of his standard of comparison is called in doubt by the opposing counsel, inasmuch as this standard is taken from foreign authorities. The jury are gravely assured, that the richness of the milk depends upon the character of the food furnished to the cow; and it is unreasonable to expect that as rich a milk should be demanded from a cow raised upon the sterile soil of Cape Cod, as is yielded by the highly-fed animals of England. It is conceivable that such representations would have their effect upon the average juryman, and hence lead to the acquittal of the accused. This popular fallacy might be easily eliminated by a chemical investigation of the milk produced under different circumstances in different parts of the State,—an investigation which thus far has not been undertaken.

The indifference of the public on this subject, has, moreover, its origin in part in the conviction that this fraud is one which cannot be successfully attacked by any individuals, or bodies of individuals, however powerful or determined they may be, but that it can only be suppressed by the interference of government; and that in this, as in other matters relating to sanitary reform, the duty rests with the State to throw so many obstacles in the way of the perpetrator, that it cannot be undertaken without incurring the danger of detection and appropriate punishment.

Still another cause for the apathy of the public in tolerating

this very general deception, is the fact that it is a somewhat humiliating circumstance to acknowledge one's self to be the victim of roguery in a matter apparently so simple; so that each consumer, though he may betray a remarkable tendency to credulity with regard to the sophistication of milk in general, consoles himself with the idea that in his own case the genuine article is supplied.

It is proposed in this paper to consider briefly, for the benefit of those who may not already be familiar with the subject, the various methods which are resorted to—or which are popularly supposed to be resorted to—for the purpose of adulterating milk, and the means which have been afforded us by chemists for their detection; to review the principal legislative enactments which have been framed for the purpose of extinguishing fraud in the sale of this article; and, last of all, to advert to the principle of the measures upon which, in our opinion, any attempt at improvement in these laws should be based.

It will perhaps conduce to a better understanding of the subject, if we, first of all, review the constituents of genuine milk, and some of the methods of examining it, and the normal variations to which it is subject.

A.

The Composition of Milk—its Variations.

Genuine milk is composed of water, holding, either in suspension or solution, fat globules, casein or cheesy matter, sugar and various mineral matters or salts.

It is a physiological fact, well known to dairymen, that the quantity and quality of milk yielded may vary somewhat, not only in different cows, but in the same cow, this variation depending upon,—

1st, *The breed of the cow from which it is obtained.*—The milk of certain cows, particularly the Alderneys, contains a very large proportion of cream, and therefore forms a very nutritious food for infants; while the milk of some other races, such as the Durhams, is richer in casein, and is on this account especially adapted to the production of cheese.

2d, *The number of calves which the cow has borne.*—Less milk is given with the first calf than with the subsequent ones.

3d, *The time that has elapsed since the last calving.*—During the first week or ten days after the birth of the calf, a yellow, thick and stringy milk, called colostrum, is secreted, which is unfit for use.

4th, *The character of the food furnished to the animal.*—Although the chemical constituents of the milk are not much affected by the food consumed, provided the food contains an equal amount of nutritious matter, yet it has been determined by careful experiments, that when cows are fed principally on carrots, there is a slight diminution in the amount of casein and butter, and an increase in the quantity of sugar; and this change becomes still more marked when beet-root is made the chief article of diet. On the other hand, the food furnished may not afford a sufficient amount of nutriment, in which case a diminished quantity of milk is secreted; or again, the food may be of an unnatural character, such as distiller's grains, in which case the milk-producing organs are unnaturally stimulated, and a large amount of deteriorated milk is yielded. If the food consists of the refuse of distilleries, then the animals become extensively diseased, and although the appetite remains unimpaired, the milk given is manifestly unfit for consumption, and its sale has been very properly condemned by legislative enactments. The yield of milk is most abundant in spring. In dry seasons the quantity secreted is less, but the quality is richer. An unpleasant taste and odor is said to be imparted to milk by an exclusive diet of turnips or oil-cakes. It is also similarly affected by certain weeds or leaves of plants, which are eaten by the cattle in dry seasons when the pasturage is bad.

5th, *The care and attention that is bestowed upon the animals, and the ventilation and cleanliness of the stables in which they are kept.*—Instances, illustrating the effect of neglect in this respect, are common, in which an exceptionally rich milk, having a high specific gravity, and yielding a large per cent. of cream is so thoroughly impregnated with the vitiated air of the stable as to be decidedly repulsive to the taste.

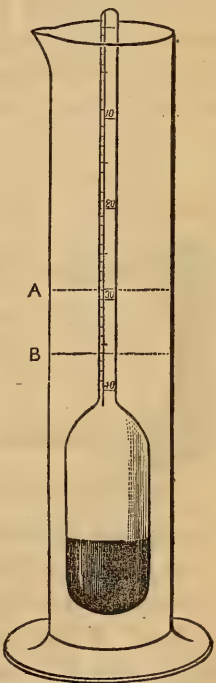
6th, *The time of milking.*—It is well known that the quality of milk from the same cow varies with the time of

milking, the afternoon milk being richer on the average by one-fourth than that obtained in the morning, and the last portion of a milking (known as the strippings) being the richest and often reserved, therefore, for cream.

B.

Methods of Examination.

A number of instruments have been employed, with the object of affording some simple method by which an approximate idea of the quality of milk may be obtained, without resorting to an elaborate chemical analysis. These are:—1. The hydrometer and centesimal galactometer, which are both specific-gravity tests. 2. The lactometer, or cream-test of Sir Joseph Banks. 3. The lactoscope. 4. The microscope.



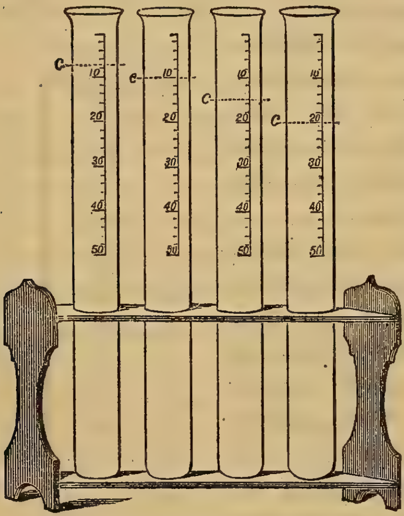
1. The Hydrometer.*

1. *The hydrometer.* This instrument alone affords an imperfect and often fallacious test of the richness of a specimen, and for the following reasons:—*First.* On account of the variation in the specific gravity of different samples of genuine milk. *Second.* Although, as a rule, milk which is rich in cream is also rich in the other fixed constituents, yet samples may undoubtedly be found which are very rich in cream, but poor as regards the other constituents, in which case the richness would be in an inverse ratio to its density. *Third.* The specific gravity of impoverished milk may be fraudulently lowered, or raised, by the admixture of various ingredients, particularly water and salt. The ordinary specific gravity of pure milk at 50° Fahrenheit ranges between 1,029 and 1,037, and it is no secret to milkmen that this specific gravity is not much changed if four per cent. of water be added for every one per cent. of cream abstracted.

* *A, B,* the range of genuine milk.

The centesimal galactometer of M. Dinocourt is designed to determine the purity of milk in precisely the same way as the hydrometer,—that is, by measuring its specific gravity. It possesses one advantage over that instrument, in that it indicates with greater accuracy the degrees.

2. The instrument known in England as the lactometer, or creamometer, is simply a long tube graduated into a hundred parts, and intended to indicate the percentage of cream which has spontaneously separated from the milk, and risen to the surface within a given time. This quantity generally measures from eight to twenty per cent., and, in certain breeds of cows, may amount to even fifty per cent. The lactometer, of course, affords no knowledge of the other constituents, such as the casein and sugar, which, in some instances, may be contained in large quantities in a sample which is not rich in cream.



2. The Lactometer of Sir Joseph Banks.*

It may be mentioned here that an instrument called a lactometer is employed in Boston, constructed upon the same principles as the hydrometer, and carried by most milkmen. This instrument indicates, upon a scale of twenty degrees, the variation between pure milk and water.

Now, if the sophistication in any given sample has been limited to the removal of cream, and the addition of water, the combined employment of the hydrometer and lactometer, subject to certain precautions (such as noting the temperature, the time the milk has stood at the period of observation, &c.), will afford a pretty fair knowledge of its character; for the effect upon the specific gravity of the addition of water is quite as marked as its influence upon the proportion of the solid constituents. This method of examination (known

* *c, c, c, c,* indicate the percentage of cream in four different samples.

in Europe as that of Müller) has been adopted in the law-courts of Switzerland, in settling all questions as to the purity of any sample; and from it there is no appeal. It is fallacious, however, inasmuch as it fails to take into account the fact, familiar to our accomplished milk-venders, that the effect upon the specific gravity of the addition of water may be entirely neutralized by the addition of certain other substances, particularly salt.

3. *The Lactoscope.*—This instrument is intended to determine the richness of milk by measuring its opacity, its operation being based upon the fact, that while the fat globules are opaque, the liquid in which they float is nearly transparent. It follows from this that the transparency of any sample is in inverse ratio with its richness, and the more water it contains, the thicker will be the layer through which rays of light from the flame of a candle, placed at a given distance, are transmitted. The percentage of fat globules may be read off upon a scale attached to the instrument. The original lactoscope was invented by M. Donné, and was favorably reported upon by a committee of the French Academy of Sciences, to whom it was referred for examination. Although it has since been improved and simplified by M. Vogel, it is not thought to present any important advantages over the lactometer.

4. *The Microscope.*—This instrument, like the lactoscope, affords a comparative idea of the richness of milk, by enabling us to estimate with the eye the number of fat globules a sample contains. By its aid, also, many of the abnormal constituents, or added ingredients may be made out, such as the casts of the lacteal tubules and pus cells, found in the case of diseased animals, starch, chalk, colostrum, as well as the infusoria and fungi which abound in milk that has stood for several days.

C.

Methods of Adulteration.

It is fortunate for the public that the practicable methods for systematically tampering with milk are exceedingly

limited, and by no means difficult of detection. It is obvious that whatever agent is employed for this purpose must fulfil certain conditions, or otherwise its presence will become patent to even the ordinary observer. Thus, it is essential that any substance added to milk for the purpose of adulteration should be perfectly soluble in the milk, for otherwise it would either rise to the surface, or else be precipitated to the bottom of the vessel in the form of a sediment. It is, moreover, important that the substance employed should not become coagulated upon boiling, nor possess any peculiar taste, odor or color which would be communicated to the milk, and thereby modify or interfere with its conspicuous and well-known properties, and thus betray the sophistication. Now the substance which best answers these indications is water, and there is, therefore, a *primâ facie* probability that this will be the agent generally chosen for this purpose, and that any other substance added will be employed with the design of concealing the effects produced by the admixture of water, with the single exception of carbonate of soda, which is added rather with the idea of preserving milk. The principal substances, then, which are employed, or which are popularly supposed to be employed, in the sophistication of milk are the following :—

Water.
Flour, or starch.
Gum-arabic, or dextrine.
Cerebral matter.
Chalk or whiting.
Turmeric, or annatto.
Gum tragacanth.
Carbonate of magnesia.
Arrowroot.
Sugar.
Emulsion of almonds, or hemp-seed.
Carbonate of soda.
Eggs.
Salt.

a. Water.—The effect of the admixture of water upon milk is, as has already been remarked, to lessen the specific gravity of the milk, so that an approximate idea may be obtained of the amount of water in any given sample, by measuring the density of either the milk, the skimmed milk or the serum. Thus, if one-fourth of a specimen is made up of added water, the hydrometer would then indicate a proportionately lower density, *e. g.*, if the sample originally possessed a specific gravity of 1,031, it would now measure

but 1,021. A better basis of measurement, however, is afforded by the skimmed milk, or by the serum. The variation in the density of different samples of pure milk is influenced chiefly by the amount of fatty matter and casein present. Now, if a few drops of acetic acid are added to the milk, these two constituents may be coagulated and removed, and in the serum which remains behind we have a factor, which in different specimens of pure milk admits of but little variation, and furnishes therefore a means of tolerably accurate measurement. The effect upon the serum of the addition of various portions of water, according to Hassall, is shown by the following table :—

Serum containing Percentages of Water.	Specific Gravity.
Pure serum,	1,029
Water—10 per cent.,	1,025
20 "	1,022
30 "	1,020
40 "	1,017
50 "	1,014

A standard of comparison is obtained from the examination of a large number of samples of known purity, by which the range of variation is ascertained. Having learned the specific gravity of the serum, and the quantity of cream present, we can form a tolerably accurate estimate of the richness of any given specimen. One source of error must however be guarded against, which arises from the fact that if sugar or salt has been added to the milk, the specific gravity may be thereby raised several degrees. The quantity of water added to a specimen may be also estimated indirectly, by determining quantitatively the amount of the solid constituents or of the milk-sugar present.

b. Flour, or Starch.—The presence of flour, or starch, may be detected by adding a few drops of the tincture of iodine to the whey of the suspected sample. If this produces the characteristic blue color, it indicates that some amylaceous substance has been added. The presence of starch may be

also made out by means of the microscope. In one or two instances, suspected milk which has been subjected to chemical analysis by Mr. Faxon, the milk-inspector of Boston, has been found to be adulterated by the addition of corn-starch.

c. Gum-arabic, or Dextrine.—The expense of this substance, and the fact that it cannot have much effect upon the density of milk, both tend to render its use for this purpose impracticable. It is detected by adding a small quantity of alcohol to the whey of the suspected sample. A dull, abundant, white precipitate falls, which may be proved to be gum by its properties, and which differs essentially from the light-bluish and diaphanous flakes which alcohol produces in pure milk. (Normandy.)

d. Cerebral Matter.—The statement that any such villainous mixture as the *brains* of sheep, or of other animals, is ever employed for the purpose of counteracting the blue tinge, or increasing the density of impoverished milk, is to be received with hesitation. This substance, if present, would speedily settle to the bottom of the vessel, and its true character could then be made out by the aid of the microscope.

e. Chalk, or Whiting.—It is not uncommonly asserted, and believed, that this substance is sometimes added to soured milk to neutralize its acidity. That any such crude adulteration is ever resorted to in this vicinity is highly improbable, for chalk, being insoluble in milk, would form a sediment, and thus lead to inevitable exposure. The addition of a drop of acid to such a sediment would cause effervescence.

f. Turmeric, or Annatto.—These substances are said to be used for the purpose of restoring the rich cream color to deteriorated milk. Their presence is determined by evaporating a portion of the suspected sample to about one-eighth of its original bulk, and then adding a small quantity of caustic potash, when the yellow color becomes brownish, if turmeric has been added, or a bright red in the case of annatto.

g. Gum Tragacanth, Carbonate of Magnesia and Arrow-root.—These agents are also said to be employed, for the purpose of adding to the consistency and counteracting the blue tinge of watered milk. The former is detected by boiling the milk and leaving it to rest for some hours, when a gelatinous deposit is found, if gum tragacanth is present. If this deposit is washed with a small quantity of water, and then tested with a few drops of the tincture of iodine, the characteristic blue color will be produced, on account of the presence of the starch contained in the tragacanth. Arrow-root is detected by means of the microscope, by which instrument the round particles of carbonate of magnesia can also be made out. The latter will be found to disappear upon the addition of a drop of acid.

h. Sugar.—This is known to be extensively employed, in the form of caramel or brown sugar, to add to the color and develop the flavor of impoverished milk. For this purpose a very small amount is all that is requisite, so that it cannot have any great effect upon the density of a sample. Its presence is ascertained by mixing a little yeast with the serum of the sample, and exposing the mixture to a temperature of between 70° and 80° Fahrenheit. An abundant and rapid disengagement of gas will take place in the course of two or three hours, which is a sure sign of the presence of sugar, for pure milk cannot ferment within so short a time, nor is the fermentation ever brisk or tumultuous. (Normandy.)

i. The Emulsion of Almonds, or Hemp-seed.—These substances are expensive, and fail in every particular to fulfil the conditions of successful adulteration. Hemp-seed would impart an unpleasant flavor to the milk, while the milk of almonds would cause it speedily to coagulate. Both substances would render the fat of milk so fluid that it would be impossible to convert it into butter, or the butter, if formed, would be of a very slight consistency. Moreover, the addition of a few drops of amygdaline to an ounce of milk containing milk of almonds, would cause the development of the odor of bitter almonds.

j. Carbonate, or Bi-carbonate, of Soda, is sometimes added in small quantities to milk, to prevent it from turning sour, and milk thus treated is said to retain its sweetness for eight or ten days. When this substanee is present, there is a slight increase in the quantity of the incinerated ash, and this ash will moreover be found to effervesce upon the addition of an acid. Other more elaborate tests are given by Normandy.

k. Eggs.—The admixture of eggs is one of the more harmless methods of improving the appearance of milk, not unfrequently resorted to in France. If any considerable portion of either the white or yolk of eggs were added to milk, its presence would be made apparent by the formation of diaphanous clots upon boiling, owing to the coagulation of the albumen of the egg. When the quantity added is very small, however, its detection by this test is difficult, inasmuch as milk in its normal state contains some albumen. It is then necessary to filter the suspected milk and boil the serum. The number of flocculi which form are then to be compared with the number produced in the serum of pure milk, which has been subjected to the same process.

l. Salt.—This substance is understood to be used pretty extensively, with the object of increasing the density of impoverished milk, and at the same time developing its flavor. Its presence is not to be detected by the ordinary observer, but is made manifest to the chemist by the weight and taste of the ash.

D.

Examination of Specimens of Milk Sold in Boston and Vicinity.

To demonstrate by accurate examination the actual extent to which the adulteration of milk is carried, is not within the scope of this inquiry, nor indeed is any such extended investigation necessary, considering that the fact of this adulteration is universally conceded.

The following statement of a physician, one of the correspondents of the Board of Health, affords some evidence on

this point, and the correctness of this statement has been virtually admitted by all who have thus far been approached on the subject:—

"The town in which I live is largely interested in the production and sale of milk, and with pretty good opportunities for judging, I doubt if *five per cent.* of the milk sold in Boston and vicinity is unadulterated when it reaches the consumer, from whatever part of the Commonwealth it may be obtained. It is skimmed, and adulterated with water, burnt sugar and salt, none of which ingredients are very deleterious, perhaps, but if the nourishment of young children in the cities is made up largely of this mixture, it will serve, in my opinion, to account for the increased rate of mortality which is referred to in the following extract from the report of the consulting physicians of Boston, in 1870:*

"'In 1868, the last year of which the records are published, four hundred and eighty-seven deaths from *cholera infantum* occurred in Suffolk County, while in an equal population outside the city limits, the number was less than one hundred. The mortality from all bowel diseases of children is in similar proportion in Boston and in the country.' *Children in the country have pure milk as it comes from the cow.*"

That this testimony, which, it is true, is of a derivative or secondary character, may not rest unsupported by direct evidence, a number of samples have been taken at random and submitted to the analysis of Prof. J. F. Babcock, who, being the official analyst to the city of Boston, has had an extensive experience in the examination of milk. It should be observed, that these samples were in each instance obtained from most respectable milkmen or grocers, and were all sold as pure and at the highest price. In no case was there any previous reason to suspect adulteration. The samples examined, though limited in number, confirm, so far as they go, the statement of the correspondent above quoted, and will serve to illustrate the fact, which milkmen do not hesitate to admit, that, in conducting the milk-trade of our large cities, *adulteration is the rule.*

REPORT OF ANALYSES BY PROF. J. F. BABCOCK.

A. H. NICHOLS, M. D., *Dear Sir:*—I enclose the results of my analyses of several samples of milk made at your request, with a view of ascertaining the quality of milk sold by some of the most reputable dealers in Boston, and the detection of adulterations, if any existed.

* See Second Report State Board of Health, page 57.

The material best adapted, and universally used, for the adulteration of milk, as you are doubtless aware, is *water*, with the addition in most cases of a little carbonate of soda, to prevent souring, common salt or sugar, to increase the specific gravity, and thus mislead those who may attempt to judge of the richness of the sample by the hydrometer test; and finally burnt sugar, annato or other coloring, to impart a rich color and overcome the blue tinge produced by watering the milk.

Salt, soda, sugar or coloring matter, being easily detected, and present only in small quantities, the examination of milk for adulterations practically resolves itself into the determination of the amount of water intentionally added, or rather the amount of pure milk and of added water in one hundred parts of a given sample.

Among the various methods which have been proposed for the analysis of milk for the detection of added water, there are two which I have found to give more reliable results than any others.

These are :—

1. The estimation of the amount of solid constituents in the milk.
2. The estimation of the amount of sugar of milk contained in 1,000 parts of the serum.

By comparing the amounts of solids or of sugar contained in any sample, with the amounts of each present in pure milk, we may obtain an approximate estimate of the amount of water added.

Pure milk being variable in quality, we have no absolute standard of purity with which we can compare any given sample, and therefore the analysis of milk for added water is at best only an approximation; but the chances of error in any analysis are all in favor of the milkman, and an examination of milk by either of these methods will, as a rule, give less adulteration than the actual amount.

The various analyses of milk given in the works of Hassall, Normandy, Miller and other standard authorities, being the results of examinations of milk produced in foreign countries, it was deemed desirable to ascertain the average quality of the milk produced in the vicinity of Boston.

For this purpose seven samples of known purity were obtained, and submitted to analysis, the results of which are given below. Great care was exercised in procuring these samples, in order that they might represent milk, not of extra, but rather below the average quality.

All the samples are those of milk raised to be sold in Boston, and were procured from cows not remarkable for the superior qualities of the milk furnished. Analysis A represents milk sold by a milkman—himself a producer—to his regular customers in Boston.

B is milk furnished daily by a producer to a physician of this city. C, D, E are samples of milk procured from a large dairy near Boston. F and G are samples of milk from cows fed on brewers' grains and salt hay, a diet which is well known produces milk of only medium quality.

Analyses of Seven Samples of Milk of known purity, produced and sold in Boston and Vicinity.

	Specific Gravity.	Cream in 24 hours, in 100 parts by volume.	Solids in 1,000 parts by weight of Milk.	Milk-Sugar in 1,000 parts, by weight, of Serum of Milk.	Ash in 100 parts by weight of Milk.	Water in 1,000 parts by weight of Milk.
A, ...	1032	11.0	144.2	55.8	–	855.8
B, ...	1034	8.5	148.1	55.5	1.08	851.9
C, ...	10 3	7.0	142.8	54.8	0.74	857.2
D, ...	35	8.0	143.2	55.2	0.70	856.8
E, ...	1033	9.5	137.1	55.3	0.88	862.9
F, ...	1033	9.0	148.0	55.1	0.94	852.0
G, ...	1036	11.0	147.2	55.3	0.82	852.8

H. Analysis of Milk from a Cow kept for the superior qualities of the Milk furnished.

Specific gravity, ...	1035
Cream, per cent., ...	24.
Solids, in 1,000 parts milk, ...	181.6
Sugar, in 1,000 parts serum, ...	56.2
Water, in 1,000 parts milk, ...	818.4

Average composition of these Samples—omitting H.

Specific gravity, ...	1033
Cream, per cent., ...	8 to 9
Solids, in 1,000 parts milk, ...	145.5
Sugar, in 1,000 parts serum, ...	55.3
Ash, in 100 parts milk, ...	0.86
Water, in 1,000 parts milk, ...	854.5

Several samples of milk sold by dealers in Boston were then obtained and submitted to analysis, to ascertain how such milk compares with that known to be pure. The specimens were procured from first-class grocers and milkmen who were supposed to deal in pure milk. Twelve samples were examined, and as will be seen by the results given below, ten were more or less adulterated.

Analyses of Twelve Samples of Milk obtained from various Dealers in Boston.

Sample No. 1.—Milk delivered to a private family at the South End.

Specific gravity, ...	1028
Cream, per cent., ...	9.
Solids, in 1,000 parts, ...	120.9
Milk Sugar, in 1,000 parts whey, ...	45.

In this milk salt and caramel were detected.

Approximate Composition.—Pure milk,		85
	Added water,	15
		100

Sample No. 2.—From a *first-class* grocer, Boston Highlands.

Specific gravity,	1022
Cream, per cent.,	7.
Solids,	114.
Milk sugar,	39.

This sample has been deprived of a part of its cream, and contains *caramel, salt* and *bicarbonate of soda.*

Approximate Composition.—Pure milk,		75
	Added water,	25
		100

Sample No. 3.—Sold as *milk from one cow.* Delivered to a private family at the South End, January 9, 1872.

Specific gravity,	1031
Cream, per cent.,	9.
Solids,	112.
Milk sugar,	42.

Considerable *caramel* and *brown sugar* were discovered in this sample.

Approximate Composition.—Pure milk,		80
	Added water,	20
		100

Sample No. 4.—"*One Cow's Milk.*"—From the same milkman as Sample 3, delivered upon the following day, January 10, 1872.

Specific gravity,	1031
Cream, per cent.,	9.
Solids,	127.
Milk sugar,	49.

Salt and *caramel* were detected in this milk.

Approximate Composition.—Pure milk,		90
	Added water,	10
		100

The analyses of these two samples of "*One Cow's Milk,*" illustrate the care taken by the milkman that the specific gravity shall be such as not to excite suspicion. A hydrometer introduced into each of these samples would indicate "pure milk," and of the same quality, whereas analysis shows that neither is pure and that one has double the amount of added water contained in the other.

The milkman, when requested to furnish better milk, expressed a cheerful willingness to have the contents of his cans "tested,"—of course, by the hydrometer, (or lactometer, as it is here called,)—and was found to be actually provided with such an instrument, by which he could "demonstrate" the purity of his milk.

Sample No. 5.—Milk sold at a grocery in South Boston.

Specific gravity,	1030
Cream, per cent.,	13.
Solids,	101.2
Milk sugar,	42.

Caramel was detected in this milk.

Approximate Composition.—	Pure milk,	75
	Added water,	25
		100

It will be seen that the amount of cream in this sample is greater than in most of the others, yet the adulteration is also great. This is of frequent occurrence, as cream rises from diluted milk with much greater facility than from that which is pure. In a diluted milk, at the expiration of twenty-four hours nearly all the cream will have risen to the surface, while in pure milk, even after it has remained standing for several days, the cream still continues to rise. This will explain how persons who are supplied habitually with watered milk, often consider it purer than the genuine article, because it gives, *apparently*, more cream.

Sample No. 6.—Milk delivered in Boston by a milkman, to a private family at the South End.

Specific gravity,	1030
Cream, per cent.,	8.
Solids,	118.
Milk sugar,	47.

Approximate Composition.—	Pure milk,	85
	Added water,	15
		100

Sample No. 7.—Milk sold by a first-class grocer near Boston Common.

Specific gravity,	1030
Cream, per cent.,	4.
Solids,	128.
Milk sugar,	48.

Approximate Composition.—	Pure milk,	90
	Added water,	10
		100

This milk had been deprived of a greater portion of its cream.

Sample No. 8.—Milk delivered by a milkman at South Boston.

Specific gravity,	1031
Cream, per cent.,	9.
Solids,	124.2
Milk sugar,	47.5

Caramel and *salt* were found in this sample.

Approximate Composition.—	Pure milk,	90
	Added water,	10
		100

Sample No. 9.—Milk from the *Massachusetts General Hospital.*

Specific gravity,	1031
Cream, per cent.,	6.
Solids,	129.
Milk sugar,	49.

This milk had been skimmed and watered.

Approximate Composition.—	Pure milk,	90
	Added water,	10
		100

Sample No. 10.—Milk from the *City Hospital, Boston.*

Specific gravity,	1026
Cream, per cent.,	8.
Solids,	115.
Milk sugar,	42.

This sample contained *caramel.*

Approximate Composition.—	Pure milk,	80
	Added water,	20
		100

Sample No. 11.—Milk delivered to a private family in Charles Street.

Specific gravity,	1034
Cream, per cent.,	8.5
Solids,	148.1
Milk sugar,	55.5

This sample was genuine.

Sample No. 12.—Milk sold to a private family in Columbus Avenue.

Specific gravity,	1031
Cream, per cent.,	14.
Solids,	143.5
Milk sugar,	55.9

This milk was pure.

From these results it appears that out of twelve samples subjected to examination, *ten* were more or less adulterated with water; that *six* were also adulterated with *caramel; four* with *salt; one* with *bicarbonate of soda,* and *one* with *brown sugar.* It is worthy of notice that the hydrometer alone would indicate that all but samples Nos. 1, 2 and 10 were of fair quality of pure milk. In fact, this instrument, which is reasonably accurate where water alone has been added to the milk, is quite unreliable where there has been an admixture of other ingredients, such as salt, sugar, &c. Indeed, it is well known that milk-dealers who are in the habit of watering their milk, do it in a scientific manner, "testing" it by means of the hydrometer, till, according to this instrument, it corresponds to mark of "pure."

In none of the samples examined was there any chalk, starch, gum, sheep's brains or other substances, so often asserted to be present in milk. These analyses confirm, moreover, the result of several hundred examinations made for the city of Boston, which indicate that nothing actually deleterious is added to milk,—water, sugar, salt, soda, &c., being as harmless adulterants as could possibly be used. The word "deleterious" must, of course, be understood to be here employed in a limited sense, for the testimony of physicians goes to show, that where the attempt is made to bring up a delicate child upon a deteriorated milk, such a child may be directly injured, and even starved, by the unnutritious character of its diet.

Yours respectfully, JAMES F. BABCOCK,
Analyst to the City of Boston.

BOSTON, January 13, 1873.

It is but fair to mention, that at the time the above analyses were made, the daily quantity of milk brought into Boston fell considerably below the usual supply, and it is therefore probable that the milkmen, finding it difficult to supply the wants of their customers, added more than the usual proportion of water to their cans. These analyses, then, though they are not to be considered as representing the average quality of the milk distributed by the best dealers, will serve none the less to illustrate to how great an extent sophistication may be carried, without even awakening any suspicions on the part of the consumer.

The experience of the Boston inspector, Mr. Faxon, has shown that the degree of adulteration is in a measure governed by the relation between the demand and the supply. During the early summer, before the wealthier classes have retired to

the country, milk is more freely used, both as a beverage and also in the form of ice-cream and other articles of food. Moreover, at this season milk cannot be kept for so long a time. Hence, though the supply is large, it not unfrequently falls far short of the demand, and water is then resorted to in order to supply the deficiency. At other times the supply may be reduced by a prolonged drought, and the consequent difficulty of finding the usual amount of fodder for the cattle.

The greater portion of the milk sold in our large cities is brought in by steam-cars from the country towns, and is handled by four or five different parties in the course of its passage from the dairy to the consumer. It is customary for the farmer or producer, to bind himself to supply to the contractor, at a fixed price, a certain number of cans * each day for a period of six months, beginning either with the first of April or October. The price per can, at the farmer's door, has been for the past few years from thirty-three to forty-two cents in summer, and about forty-five cents in winter. The contractor, or his agent, gathers up the cans left at the different stations by the farmer (or in the larger towns by the collector, who is employed to transfer the cans from the farmer to the station), and under his charge they are transported in a car provided for that purpose to the depots in or near the city. From these depots the cans are taken by the milkmen, by whom the milk is sold at retail to private families, or distributed among the grocers. The prices obtained by the contractors at the depots is from forty to forty-eight cents a can in summer, and about fifty cents in winter. The milkman sells to the grocer at the rate of fifty to sixty-two cents a can, while the price paid by private families is either eight or nine cents a quart.

It has been estimated that the daily supply of milk for the city of Boston for the year ending March, 1872, was 24,009 gallons, which for the entire year would amount to 8,763,285 gallons, the cost of which to consumers may be reckoned at $2,979,516.90. If we assume the average amount of water fraudulently added to be but twelve per cent., and this is putting it at a low figure, the amount expended by our citizens

* The cans used on different railroads are of two sizes,—one containing nine and one-half quarts, the other eight quarts and one-half pint.

during this year for water, apart from the legitimate water-rates, amounted to the sum of $357,541.92.

To indicate more accurately the full amount of the fraudulent gains in this trade, there should be added to this sum the value of the cream poured off from the top of the cans, and sold by the milkmen at a price varying from twenty-five to fifty cents a quart.

It would be foreign to our object to attempt to show where, or by whom, the process of sophistication was in any particular instance carried on, although on this point abundant and conclusive evidence is within reach. The Milk Act now in operation very wisely holds the milkman responsible in all cases for the quality of the article sold by him, and it lies within his power to protect himself from imposition on the part of the farmer or contractor, by requiring his cans to be delivered to him sealed with the stamp and name of the producer.

E.

Legislative Enactments with regard to the Sale of Adulterated Milk.

It may be desirable for the benefit of those who have not been led to investigate this subject to review briefly the nature of the enactments passed, at different times, by the state legislature, with reference to the sale of deteriorated milk, for it can thus be more easily pointed out in what respect these laws have been imperfect, or inefficient.

The first specific statute designed to punish fraud in this respect was passed in 1856. The punishment inflicted by this statute was a fine of twenty-five dollars for the first offence, and for any subsequent offence a fine of fifty dollars, or imprisonment from two to six months in the house of correction. It authorized all persons to make complaint, and prosecute to final judgment in our courts any violation of its provisions. The expensive burden of chemical analysis and of legal prosecution was thus thrown upon the victim of the fraud, a burden which, as may well be supposed, few individuals would volunteer to assume. As no prosecutions were ever attempted under this law, its effect was to afford complete immunity to roguery.

During the year 1858, the adulteration of milk began to attain to such magnitude, that public attention was very generally directed to it. Medical evidence was brought forward to show that the high rate of infant mortality in the large cities, during the warm weather, could be referred in no small degree to the unnutritious and indigestible character of the milk furnished at that season. The facts elicited at that time led to an improved and more stringent enactment, looking to the suppression of fraud by the obligatory appointment in cities of inspectors of milk, and the detection, conviction and punishment of adulterators. In August of that year (1859) the first inspector was appointed in Boston.

By the law of 1859 it was ordained that—

"No person shall offer for sale in this Commonwealth milk produced from cows fed upon the refuse of breweries and distilleries, or any other substance which may be deleterious to the quality of the milk, under a penalty of ten dollars for each offence."

This section, so far as it relates to brewers' grains, was obviously intended by its framers to apply to milk sold in certain localities, yielded by cows fed *exclusively* upon brewers' grains, it being well-known that an impoverished milk was induced by this unnatural diet. When, however, prosecutions were commenced under this law, chemists were introduced by the accused, who testified that cows could be fed *principally* upon these grains without any deleterious effect upon the quality of the milk yielded. It having been made to appear, therefore, that scientific men are not altogether in accord upon this question, the trial resulted in the acquittal of the defendants, and in consequence of this failure to obtain convictions, this portion of the law was subsequently repealed. It seems strange, that no attempt was made at that time to submit to competent analysis any samples of milk secreted by the animals who were really aimed at by the law, but that the *ex parte* evidence of so-called "experts," who themselves did not pretend to any experimental knowledge of the milk in question, should have the effect of nullifying that portion of the law, and causing its subsequent repeal.

The punishment inflicted by the law of 1859 was the insignificant fine of twenty dollars, nor was a second conviction attended by any increase of the fine.

By the law of 1863, the penalty was raised to fifty dollars for a second offence, and imprisonment in the house of correction for any subsequent offence. It also provided that the name of the offender should be published in two newspapers, printed in the county where the offence was committed. This last feature, *the publication of the name*, has in reality proved the one which is invariably the most dreaded by the delinquents.

In 1868, the penalty was fixed at one hundred dollars for the first offence, while a second conviction was made punishable by a fine of not less than one hundred, nor more than three hundred dollars, and imprisonment from thirty to ninety days. Another important change was made, however, at the same time, which served to render the whole statute almost useless. This change consisted in the ingenious insertion of the words "*knowing the same to be adulterated*," thus throwing the onus of proving guilty knowledge upon the government, inasmuch as it involves the production of testimony, which in the great majority of cases, is not accessible.

Soon after the passage of this Act, clear cases of gross adulteration were ferreted out, and laid before the grand jury, by the Boston inspector, Mr. Faxon. There was no doubt but that the samples seized were sold by the individuals accused, and a chemical analysis gave proof of the extent of the adulteration. Proof was wanting, however, that the accused were aware that the article sold was adulterated, and inasmuch as it appeared, in the absence of this proof, that no successful action could be maintained against these parties in court, no bill of indictment was rendered against them. The year that this law was in force, was marked by a large falling off in the number of complaints made in Boston. The number of bills of indictment returned by the grand jury, which, during the previous year amounted to twenty-one, was reduced under the law of 1868 to *two*, so that but very imperfect protection was afforded the public by this statute. The experience of this year illustrates pretty forcibly the effect of throwing upon the shoulders of the government the burden of proving guilty knowledge. The effect of this limitation was to render the law, in a large

majority of cases, unavailing, and thus to seriously interfere with the due administration of justice.

If the vender of impure milk is to be acquitted in our courts, because proof cannot be afforded of guilty knowledge, the inevitable tendency of this misplaced leniency will be to offer an inducement to carelessness and fraud. If, on the other hand, it is desired to protect the public from imposition, then the fact must be recognized, that in the sale of milk, as in the sale of drugs, it is not unreasonable to demand on the part of the vender the possession of a certain amount of knowledge, sufficient to enable him to estimate the character of the article tendered for consumption, and that in a matter which concerns so intimately the public welfare, any ignorance, neglect or carelessness should be held to be equally culpable with guilty knowledge.

The anomalous character of the law of 1868 having been made evident, upon the reassembling of the general court, the Act was changed, so that proof of guilty knowledge is no longer required. The law of 1869 took a more lenient view of the nature of the offence, in that it limits the amount of the penalty to not less than twenty, nor more than one hundred dollars for each conviction, making no mention of imprisonment, a punishment which has never yet been inflicted for this crime. By the statute of 1870, the sale of skimmed milk, in the place of pure milk, was forbidden. During the session of 1872, additional attempts were made to modify the Milk Act, so that as it now stands, its punitory clauses are as follows :—

AN ACT to prevent the Sale or Exchange of Adulterated Milk.

Be it enacted, etc., as follows:—

SECTION 1. Whoever sells or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, adulterated milk, or milk to which water or any foreign substance has been added, shall for the first offence be punished by a fine of not less than twenty, nor more than one hundred dollars; and for any subsequent offence, by a fine not less than fifty, nor more than three hundred dollars.

SECT. 2. Whoever sells or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, as pure milk, any milk from which the cream or any part thereof has been removed, shall be liable to the penalties provided in the preceding section.

SECT. 3. Whoever knowingly sells or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, adulterated

milk, or milk to which water or any foreign substance has been added, shall for the first offence be punished by a fine of not less than fifty, nor more than three hundred dollars; and for any subsequent offence by a fine not less than one hundred dollars and imprisonment in the house of correction not less than thirty, nor more than ninety days.

* * * * * * * * * *

SECT. 6. This Act shall take effect upon its passage. [*Approved May* 4. 1872.]

Although not expressly stated in this Act, it is understood that the law of 1863 requiring the publication of the names of the offenders, when convicted, is still in force.

It must be obvious that, as the law now stands, owing to the difficulty necessarily experienced by the government in proving guilty knowledge on the part of the accused, the great majority of convictions will be made under section one. Furthermore, such are the proverbial delays in the administration of justice, and so frequent are the changes in our statutes, that the danger of conviction for any second offence is comparatively slight. The punishment, then, which under the present law is to be feared by offenders in case of detection, is the infliction of a petty, nominal fine, barely representing the amount of their peculations for a single week, and the publication of their names in the public journals. But, as has already been shown, milk is now so skilfully and systematically sophisticated that, as the milkman well knows, its inferior quality cannot be detected by the instrument ordinarily employed for testing it, and he finds, therefore, from experience that, unless his roguery is carried on to a reckless extent, he will incur but little danger of even falling under suspicion.

F.

CONCLUSIONS.

The provisions of the Milk Act now in force are the result of repeated efforts on the part of the legislature to frame an efficient law for the suppression of fraud, the previous enactments being in a measure experimental, and serving, so to speak, as stepping-stones to the present statutes. It is manifest that this law, as far as it goes, serves as a check, and only a check, upon the evils it is designed to suppress. These evils are threefold.

First. They affect the pockets of the producer by operating through the laws of supply and demand. The artificial increase of the supply has a tendency to restrict the demand, for genuine milk, and this necessarily causes a diminution in the price paid at the farmer's door, so that the profit afforded to him is now reduced to the *minimum.*

Second. The moral influence of a statute which aims only at restricting or limiting fraud, is obviously most injurious and demoralizing to honest dealers. What inducement is offered to the milk-seller to supply genuine milk at nine cents a quart, when, thanks to the ignorance of his customers, a sugared and diluted article is equally,—perhaps even more,—satisfactory to them at the same price? How is he to compete with his dishonest rivals in the trade, if no encouragement be held out to him to furnish the article in its natural condition?

Third. The deleterious effects upon the young and aged, as well as upon certain classes of invalids, all of whom rely for their sustenance upon the milk furnished by the milkmen, can scarcely be overestimated, and are so manifest as not to require recapitulation.

While frequent changes in the statutes are to be deprecated as offering additional loop-holes to offenders, experience has shown that no radical remedy can be expected from the present Milk Act, even when every effort is exerted by the most trustworthy officials to faithfully carry out its provisions. In the city of Boston the law has been vigorously and honestly administered, and it is satisfactory to know that through the efforts of Mr. Faxon, some of the more unscrupulous offenders have been exposed in the journals, this being, in fact, the part of the punishment which touches them most keenly. But it has not been deemed expedient, even in Boston, that any attempt should be made to bring to justice instances of fraud in which adulteration of at least fifteen per cent. cannot be proved by chemical analysis. In most other cities the inspector appears to be a sort of *succedaneum,* nominally holding the office, while his time is, in reality, occupied with other official duties, so that the law in these places remains nearly a dead letter. May it not be hoped that as public opinion becomes less apathetic and better informed, that our

statutes may be so reinforced as to become remedial rather than palliative; that thereby even the milder forms of malpractice may be successfully attacked?

To attain this result it is essential, in our opinion, that the punishment for this offence should be put in harmony with the sentiments of the community; that this punishment should be rationally severe, so as to attach to those convicted some stigma proportionate to the heinousness of the offence, and at the same time outweigh the amount of profit to be derived from the fraud.

As a starting-point, then, for improvement in this act, we are of the opinion that the penalty for the first conviction should be changed from a fine to *imprisonment*. Once let it be held *in terrorem* over this class of offenders that if detected they will be incarcerated, for even a brief period, in one of our public institutions, and the adulteration of milk will be viewed in a different light by jurors and the public, and will at the same time be rendered an unprofitable speculation for milkmen. To render the law more definite, and leave less to the discretion of juries, it is important to establish a uniform standard of comparison other than that of foreign authorities,—that is to say, to determine the limits beyond which the composition of pure milk is known not to vary, a point which could be easily settled by competent chemists. Milk which does not come within those limits would then fall under condemnation, whether its impoverishment were caused by skimming and watering, by the illness of the animal from which it was obtained, or by the unnatural character of the food furnished.

The adoption of such a uniform standard would also have the effect of preventing the introduction of the conflicting statements of incompetent *experts*, by which the minds of the jurors are so often hopelessly perplexed in this class of legal cases, wherein so much depends upon the unanimity of the scientific testimony. The law should further provide for the appointment of competent local analysts, to whom suspected samples may be submitted by the purchaser for examination at a moderate rate of charge, the fee paid to the analyst being reckoned, in case of conviction, as part of the costs to be recovered from the defendant.

But it must be borne in mind, that the prevention of crime depends quite as much upon the certainty, as upon the severity, of the punishment, so that, even after a stringent law has been framed, the independent action of individual communities and of local authorities is essential to give efficiency to its provisions.

ANALYSIS OF A CORRESPONDENCE

ON SOME OF THE

CAUSES OR ANTECEDENTS OF CONSUMPTION.

By HENRY I. BOWDITCH, M.D.,
CHAIRMAN OF THE STATE BOARD OF HEALTH.

ANALYSIS OF A CORRESPONDENCE ON SOME OF THE CAUSES OR ANTECEDENTS OF CONSUMPTION.

BOSTON, Nov. 10th, 1872.

To the Members of the Massachusetts State Board of Health.

GENTLEMEN:—In accordance with a vote passed by the Board, the following circular and list of questions were prepared. Some of these questions are evidently connected with what are usually deemed antecedents of consumption in Massachusetts, while others may seem to have little bearing upon them, and may be deemed futile or irrelevant.

Following a plan I have pursued in other kindred investigations, I prepared them so that they might be answered even monosyllabically, while they did not prevent, but rather invited, more detailed answers.

The result has been that I have received responses from over two hundred physicians. The tabular statements that will be given under each question are founded on returns from two hundred and ten. Other letters were received after the calculations were finished, and these are given either in the body of the correspondence or in an appendix. One hundred and forty-two came from Massachusetts, and sixty-eight from other parts,—Maine, Vermont, New Hampshire, Connecticut, Rhode Island, New York, Pennsylvania, Illinois, Michigan, London and Germany. These correspondents are physicians in active practice. Some of them are the most prominent men in the places where they reside,—prominent for their personal qualities, and as physicians. They represent at least tolerably well the medical profession of the various places from which they write. The "medical opinion," therefore, on the various questions, which comes from them, is worthy of the respect not only of this community, but of any one who feels an interest in the questions themsveles.

It may seem to many, as I have already stated, that the questions might have been very differently and better prepared; some that evidently might have been asked do not appear on the list. On the questions of intoxicating liquors, and their effects towards the production of consumption, it may seem that I have been too diffuse. The interest in the vast subject of intemperance in this community, and the obvious design of the legislature that, if possible, the various questions connected with the subject shall be discussed by our Board, is my only excuse for any prolixity that may be noticed in this particular.

If my life and health are spared, I hope, at a future time, to give more particularly my own views on the possible "Prevention of Consumption in Massachusetts." The labor involved in such a work will necessarily be long and irksome, inasmuch as I hope to have it based on private records of the cases of consumption I have seen since March, 1839; that is, during a period of thirty-three years. It is impossible for me to say how soon I can accomplish this object.

Meanwhile I remain, gentlemen,

Your friend and colleague,

HENRY I. BOWDITCH.

MEDICAL PUBLIC OPINION

ON

CERTAIN QUESTIONS PROPOUNDED BY THE STATE BOARD OF HEALTH,

ON SOME OF THE

CAUSES OR ANTECEDENTS OF CONSUMPTION.

The following circular and accompanying questions were sent out to our correspondents. The twenty questions will form so many subdivisions of this paper. After these will be found, in an appendix, certain more elaborately written letters, some of them coming from eminent physicians :—

COMMONWEALTH OF MASSACHUSETTS.

[Circular.]

STATE BOARD OF HEALTH, BOSTON, July 6, 1871.

DEAR SIR :—The State Board of Health has requested its chairman to report upon the means of preventing consumption.

The following schedule of questions has been drawn up by Dr. Bowditch for circulation among our regular correspondents, and other physicians, in the various parts of New England and elsewhere.

It is hoped that those who may receive it will be ready to assist in the collection of facts, by at least replying with a dot or dash under the words "Yes," or "No," opposite the different questions. But Dr. Bowditch will gratefully receive more detailed statements, and especially cases relating to family or personal history, involving the apparent causes or antecedents, or means of preventing this too frequently fatal disease.

As our report must be ready at the close of the present year, and time will be needed to analyze the returns, the undersigned would respectfully request that replies be made at as early a day as our correspondents may find convenient.

In behalf of the State Board of Health,

Very respectfully, your obedient servant,

GEORGE DERBY, M. D., *Secretary.*

(This half-sheet can be returned, in the accompanying envelope, to the Secretary of the Board, with such additional information as our correspondents may be willing to furnish.)

Opinions of Dr. ________ of ________, State of ________

1. Is consumption caused or promoted by hereditary influences?
2. Can consumption be apparently prevented from occurring in children so hereditarily disposed?
3. What special means can be used for such prevention?
   (If so, please name these means on another sheet.)
4. Is consumption caused or promoted by the drunkenness of parents?
5. " " " " " " of an individual?
6. " " prevented " " "
7. " " " by total abstinence "
8. " " caused or promoted by the " "
9. " " " " overstudy at school or college?
10. " " " " overwork in trades?
11. " " " " special trades?
12. " " " " overwork of any kind?
13. " " " " severe bodily injuries?
14. " " " " " mental trouble?
15. " " " " marriage?
16. " " checked by marriage (child-bearing, &c.)?
17. " " caused or promoted by inordinate sexual indulgence?
18. " " " " contagion or infection?
19. " " " " exposed location of dwelling?
20. " " " " wet " "

Of course, the above are only a few of the causes that might be suggested. It is hoped that if any correspondent knows of any peculiar circumstances which he may deem important, in reference to the disease, information will be given in detail, as all facts upon the various questions will be gratefully received.

First Question.

Is Consumption caused or promoted by Hereditary Influences?

We have the following result from our correspondents:—

Yes,	205	
No,	1	
No reply,	4	
Total,		210

This table shows at a glance that only one of two hundred and ten physicians denied the great importance of hereditary influence in the production of consumption. Coming, as these returns do, not from theorists, but from physicians who see families grow up and die under their own care, this re-

sult, though perhaps not unexpected by some readers, certainly not by myself, is very significant. If we can ever have faith in medical testimony, every parent, and, still more, every one preparing, by marriage, to become a parent, should consider himself as forewarned by the above table. Still further, will not the State feel obliged, at some future time, to restrain the marriage of persons liable to breed consumption, even if it be considered improper and contrary to liberty, at present, to interfere with or prevent any such marriage, however inevitably it may be destined to produce a consumptive, wretched progeny? Massachusetts has yet much to do in "Stirpiculture," ere she can claim to be really a mother to her people.

Until that period arrives, each man and each woman is bound to consider this most important question before marriage.

I am well aware that this caution may seem to ignore all those keener instincts and emotions which usually govern the attractions of young people to each other before marriage. I know, moreover, the beauty of that self-sacrifice which would, at times, unite one healthy young person to another perhaps far advanced in disease. But sentiment must be ignored in any suggestions drawn from these tables of God's law, whereby we know that the defects, as well as the high qualities, of the parent descend upon the child "unto the third and fourth generation."

Extracts from our Correspondents' letters relative to this question.

Brown.—I do not remember to have seen a well-marked case of consumption where I could not trace the taint in the ancestry of the patient.

Burr.—I can call to mind several families where I have been able to trace consumption through three generations.

Gott.—Whole families are swept off by the hereditary taint. I saw, the other day, a youth of sixteen, just gone with the disease, who is the sixth of eight children that have died of the disease. I have noticed where the disease has been so destructive, that the complexion is blond,—light and light eyes.

King.—I do not remember any case of consumption which did not appear to have an hereditary foundation.

Parks.—The only case to contra-indicate a belief in the hereditary tendency of consumption, and favoring the theory of Niemeyer—which I recollect—was one of fatal pulmonary consumption, in which for a year, or upwards, preceding the pulmonary consumption (as fully declared by rational symptoms and physical signs), there were several attacks of acute bronchitis, which could not be accounted for by exposure to cold or otherwise. The patient was an only child, whose mother is now living, at an advanced age, and whose own two children (her only ones) are living, and not consumptive adults. The patient's father I know nothing of.

Hurlbert.—I find here, young men (born of consumptive mothers), who follow the sea, and have fine, well-developed chests, who are as often the victims as those who stay on shore, and are not nearly as well developed. All our sea-faring men are well formed, but it does not protect against the deadly germ of a consumptive ancestry. Oftentimes I find a whole family tainted with this dreadful plague, when the parents are cousins, and no hereditary influences are traceable.

Gammell.—I will cite the case of a family living in Berkshire County, the facts of which are all authentic. The father, to-day, is a hale old man, over ninety years of age; the mother died of phthisis about twenty years ago. Of the thirteen children, four have died of the same disease; of forty-eight grandchildren, eight have died of the same. These all have occupied places of ordinary healthfulness, and all have been engaged in agricultural pursuits.

My opinion is that hereditary influences are rapidly developed under the influence of soil-moisture, or any cause that lowers the vitality, and that any employment which deprives such a person of sunlight, pure air, or out-of-door exercise, conduces to the development of the disease.

Bonney.—About the year 1831, Rev. Dr. B——— came to this place from Boston, and was settled over the Congregational Church. The last years of his residence here he occupied a house, situated upon an apparently dry and healthy and slightly elevated piece of ground; but the sills were near the ground, and from the bank (once the margin of the Connecticut River) some three or four rods distant from the house, issue numerous springs.* I am told that the doctor's wife was confined to her house in Boston, at one time, for a year, with some form of skin disease.

The following is the mortuary record:

Eldest daughter—L——,	died Feb. 2,	1837.	Age, ...	22
Mother, ...	" Dec. 16,	1838.	"	43
Second daughter—L——,	" July 12,	1839.	"	22
Father, ...	" Mar. 22,	1839.	"	53
Third daughter—N——,	" Apr. 30,	1840.	"	23
Fourth daughter—E——,	" Oct. 4,	1840.	"	20
Eldest son—J——,	" May 4,	1839.	"	15
Youngest son—E——,	" Sep. 22,	1839.	"	2½
Youngest daughter—H——,	" Sep. 22,	1855.	"	20

One son has died since, at a distance—I don't know the particulars. One son is still living, aged about forty. The son J—— is reported to have died of diabetes; all the rest, of consumption. N—— died at Hanover, N. H. H—— lived all but two or three of her earlier days in S. H, and died

* See answers to twentieth question.

there. I am told that the Rev. Doctor stated that his father's family were consumptive.

Mrs. L—— D——— had two sisters die of consumption, and two of cancer. Three of her own children have died of consumption. One brother of her husband has lost three children by the same disease. Another brother has lost two children by the same.

C—— W——, an intemperate man, died of consumption. One or more sisters died of the same. He has lost at least four children in the same manner, one of whom had lived in Texas, one in Hadley, one in Northampton, and one in Chicago; the circumstances all being different as to occupation and mode of life. I am satisfied that the disease is decreasing. The town is much more dry, the food is of a better quality, and the people understand more fully the sanitary conditions essential to health.

I cannot but call attention to the excellent suggestions contained in the following remarks on the different influences affecting the Irish, in Ireland and in America.

Gavin.—Hereditary influence in causing phthisis is very far from being as common as medical writers would lead us to think. The majority of those who have come under my care were free from such cause. To those who are acquainted with the habits of the Irish, in their own country, as well as in America, there is much that deserves thought, and also throws light on one cause for phthisis, and points to the great importance of climatology. In Ireland, the peasantry live on diet principally made up of saccharine and fatty substances—potatoes and milk—while in this country, meat and bread form their principal diet. Again, in Ireland, the peasantry live in ill-built houses, but if they do, the doors are seldom closed, thereby insuring a good supply of pure air. Quite the contrary here—overcrowded tenement-houses, with small rooms opening into dark passage-ways, doubtful neighbors, and other things combined, oblige them to live with closed doors, so that ventilation is next to impossible. I am very much inclined to think that further investigation will show that the two agents above mentioned—radical change in diet and want of pure air—play a great share in producing phthisis amongst the Irish class of the community. In this respect I agree, to a certain extent, with Dr. W. McCormac, of Belfast, Ireland, who considers carbonized air the great factor in causing consumption.

The apparent good influence of alcoholic stimulants may be noticed in the following instance:—

Morse.—J—— B——, a man of wealth and healthy family; residence could be called an eminently healthy one. He married Miss S——. The S.'s all had consumption. He had three sons and five daughters. All the sons and three daughters died of consumption. The eldest son (J. B., Jr.) married S—— B——, whose mother died of consumption. S—— B—— died of consumption, and all her children, viz.: three daughters and one son. J. B., Jr., marries again, and before he died, begat a son, who, for many years was considered consumptive—had diseases of bones of face, fingers and hand, called *scrofulous*, which undoubtedly were *tubercular*, but by the use of concentrated nourishing food, pure air, and sunlight, he is now living, and apparently well. All medicines were dropped, and milk and brandy were substituted, when he began to gain, and his sores healed.

Hills.—Consumption seems to be caused, in some cases, by hereditary influences: by which I mean that consumption occurs in the children of parents that have died of consumption, or where the uncles or aunts have died of that disease. There are other cases where a parent has died of consumption, in which we find the children troubled with a scrofulous condition; such as enlarged glands, a puffy appearance of face, and sometimes of other parts of the body which does not seem to be firm flesh, or *adipose tissue.* My experience is too limited to be able to tell the result of such cases.

The following is analogous to statements already made above, in regard to the Irish in America:—

Huse.—As regards the development of phthisis, not from any hereditary taint, but apparently wholly from local causes I will cite the following:—A family of eight, the parents stout, athletic Irish people, with six children. At the date of my first acquaintance with them, March, 1866, they were all well, with but one exception. This was supposed to have been a cold, the result of suppressed menses from wet feet a month before. It was found to be a tubercular trouble, and proceeded to softening, and excavation in eleven weeks from the time of my first visit, when death ensued from phthisis. About the same time, a brother aged twenty-eight to thirty, consulted me, relative to cough: I found roughened respiration at the left top—no particular emaciation. I ordered cod-liver oil and whiskey, and advised him to leave town as soon as possible. One year later (1867) I examined the lungs of another daughter of the same family, and found tubercle and condensation of the top of the left lung so marked that there was no doubt in my mind as to the diagnosis and probable result. The brother went to Worcester; returned in 1869; came under my care and died in April, of dropsy, the result of chronic peritonitis with diarrhœa. The only child now at home is to all appearance healthy, but still has a marked resemblance to her deceased sister. Two remaining sons are in different parts of the country, location and health unknown. The parents are healthy Irish, living plainly, but substantially, on a farm.

Gould.—Happily consumption has almost deserted this town (Revere); there has not been a fatal case for years,—not since I wrote last upon this subject. Upon your first question I answer, Mrs. W——— died quite a number of years ago of consumption, between fifty and sixty years of age; her sister died at about the same age, and her brother died, aged sixty-three, of consumption. Mrs. W.'s daughter, M., married, died of pure tuberculosis of left lung, between her fortieth and fiftieth years. Mrs. W.'s son, R., had repeated attacks of hæmoptysis, and died after his thirtieth year. Another sister has been in a consumption for more than thirty years, and lives on. Her case is somewhat remarkable. For quite a number of years she has had repeated attacks of hæmorrhage, but instead of producing a debilitating effect, it relieves the oppression and soreness of the chest. She has been under my care for more than twenty years; uses no medicine, except an occasional dose of Morphia when the cough is too troublesome, also Tinct. Iodinii, and occasionally blisters, after taking cold. She is married, and over fifty years of age. My care has consisted chiefly in attention to the digestive organs. She has lost one son, aged thirty, by this terrible disease, and has other children fairly candidates for the same affection. The cases I report look

very much like hereditary consumption. The taint may continue to affect the offspring of this family, unless stronger and purer blood be mingled with it. But I have, until recently, firmly believed that, unless there was an hereditary predisposition to the disease, neither exposure, manner of living, nor the habits of the individual, pneumonia, bronchitis, nor any other inflammatory affection of the respiratory organs, would have the slightest effect in producing it. But, within a few years, I have been somewhat shaken in this belief. I have met with several cases, and have one under my care,—a young man of eighteen, who has a good chest and broad shoulders, and who has all the rational and physical signs of confirmed phthisis, and yet there is no family taint. None of his ancestry on either side, nor any collateral branches of the family, ever died of consumption; but the maternal branch of the family were asthmatic. It was apparently brought on by exposure to cold, producing severe capillary bronchitis and engorgement of the lungs.

Rice.—I know that many cases of pulmonary phthisis in this vicinity can be traced to hereditary descent. Often it is traceable to the second and third generation back.

Wakefield.—No doubt upon the point, that where the parents (one or both) are affected with tuberculosis, the offsprings are sure to inherit the disease.

Hunt.—Hereditary predisposition and the scrofulous diathesis cause it.

Call.—Nearly every case I have seen has had a decided hereditary influence, although every child born of consumptive parents does not die of consumption. Almost every patient dying of consumption has had some near relative die of the disease.

Butler.—Of its always being traceable to hereditary causes I have some doubt, for I have known of cases where no hereditary predisposition could be traced.

Howe.—I believe consumption to be hereditary, and, also, the inherited tendency to be the predisposing cause; but I do not believe this cause *of itself* sufficient to produce a fatal result in nearly all who may have this cause operating in the system from birth. * * * * The tendency may remain dormant during life, unless other conditions favorable to the disease should arise.

Second Question.

Can Consumption apparently be prevented from occurring in children, hereditarily predisposed to the malady?

The tabular statement is as follows:—

Yes,	120
Can be retarded,	15
No,	20
Doubtful,	10
No reply,	45
Total,	210

On this question of the ability of the medical profession to do anything to prevent consumption from appearing in children hereditarily liable to it, there is evidently much less certainty on the part of our correspondents than is shown by them on the first question. Fifty-five (26.23 per cent.) are either doubtful, or return no answer. Twenty (9.52 per cent.) return a peremptory "nay," as if they had seen few, if any, cases in which, after all had been done to prevent consumption, complete success had been the result.

Doubtless, all physicians have seen cases similarly suggestive of doubt of their ability to ward off the tremendous influence of blood. Fifteen (7.14 per cent.) think not that it can be absolutely prevented, but that it can be retarded. And finally, one hundred and twenty (57.14 per cent.) declare that they believe that the disease can be, by proper means, prevented in those children who are hereditarily predisposed. What these means may be, we shall, perhaps, get a glimpse of under another question. Meanwhile, let us take courage from the fact that more than half of our correspondents do have some hope of being able, at times, to influence the stern rule of one natural law by pitting against it other of nature's equally powerful influences.

Extracts from our Correspondents' letters relative to this question.

Packard.—Although not prevented in one or two generations, it may be in a series of begettings.

Stone.—Attention, care, and change of residence may do much.

Parton.—I do not think plain "yes" or "no" are admissible answers to this question. My opinion is, that a child, hereditarily predisposed to consumption, may be so managed as to have the development of the hereditary taint retarded, but to be prevented, I doubt. Contracted and ill-ventilated apartments are often a cause, and should be avoided.

Blodgett.—I am not aware of any such case, but I believe that much may be done by a correct system of prophylaxis to retard its development.

Gilbert.—Not generally, but occasionally with those who are intelligent, and have means at their command.

Third Question.

Are there any special means that can be used to prevent the development of Consumption in children hereditarily disposed?

The following is the tabular statement of "opinion":—

By general hygienic measures,	24
By various specific directions, more or less elaborately described,	96
No means known to prevent it,	12
Doubtful,	5
No reply,	73
Total,	210

The large number of physicians who, while answering our other questions, feel compelled to refuse any reply to this one, and those who are doubtful, and finally those who answer in the negative, that they know of no special means of warding off consumption in those hereditarily predisposed to it, making in all 90 (42.85 per cent.), presents of itself a decidedly disheartening result in reference to the power of the medical profession to prevent this terrible disease from developing itself, even when forewarned. It proves, however, one thing, viz.: that, in the opinion of a large body of physicians, other and more thoroughly radical measures must be tried than those heretofore employed, before we can hope to cope with the fate impending over the child born of consumptive parents. And on looking at the answers of those who give an affirmative reply, we find only one hundred and twenty, out of the two hundred and ten (57.14 per cent.), who think that they can succeed in preventing the disease from coming on. Upon those special means beyond a "general hygienic treatment," which 24 (11.43 per cent.) believe in, we must refer to the more detailed answers under this question. This is a sad result, but notwithstanding all this want of faith in our power to ward off the disease in an ill-begotten child, I cannot but hope that in the far future, when men will think carefully when choosing their residences in which they

intend to rear their future families; and when a child is born, all the excellent hygienic laws that may be daily laid down for childhood and youth shall be fairly acted upon, every hour that the child is growing, and while youth is budding forth to manhood and womanhood; when professions and all trades shall be chosen with reference to the health of those who are to pursue them; when people learn that sun and air must freely bathe every part of a house; when men and women shall believe that it is impossible to violate a single law of nature without more or less suffering of body or mind as a consequence of that error or deliberate crime against nature's laws; when these halcyon days shall arrive, then we shall be better able to cope with this hereditary tendency, and, perhaps, shall then be able to crush it out. I think I have seen such cases where a discerning parent has warded off threatened disease, and has so reared a family that it has become even stronger than the average. He has done this, however, by commencing at their birth, and by constant, never-remitting care in reference to every influence which, during their tender years of growth, could have any deleterious effect upon their health. He believed that even one small error might sacrifice a life. His success, as I have stated, has been complete.

Extracts from our Correspondents' letters relative to this question.

Kingsbury. Change of climate, living and occupation, together with alterative medicines.

Curtis.—Sunlight, air and muscular development.

Bowen.—Out-door life and change of climate.

Goodrich.—Plenty of pure air, light and out-door exercise.

Stone.—Change to dry and even climate, from Cape Cod to St. Paul, Minnesota.

Blodgett.—By a correct system of hygiene, avoiding all that tends to lower vitality.

Brown.—I am not aware of any that have proved successful in finally securing the systems of those who are hereditarily disposed. Its development may be, and often is, postponed for a time by careful management.

Nye.—Regular habits of living; dwelling on high and dry land; temperate habits; warm clothing; good food, at proper times, and which should be eaten in a proper manner, thereby keeping the digestive and assimilative organs in a healthy condition; and, lastly, by breathing good air by night as well as by day.

Chase.—Change of air, climate, diet and general hygiene.

Dickson.—Bathing regularly, careful selection of food, regularity of hours for sleep.

Hathaway.—Proper diet, clothing, habits, climate, &c.

Deane.—Change of residence, habits of life and mode of living.

Reynolds.—Not *special* but *general* measures, attention to the rules of health, avoiding causes mentioned in Nos. 9, 10, 11, 12, 17, 18, 19, 20 of the circular.

Tracy.—I am not quite sure that I understand fully the intent of question 3. I know of no *specifics*, but, at the same time, my impression is that each case calls for special means, according to the peculiar constitution or condition or circumstances of the individual. In some, change of climate; in others, the use of iron; in another, cod-liver oil; in another, alcoholic stimulants; in another, change of circumstances, &c., &c. *In all*, the use of those means which will tend to *health*, in both mind and body.

Chapin.—Judicious food, extra clothing, and removal from all local causes.

Adams.—In the predisposed, especial attention to all the *little* precautions; especially in dress.

Smith.—Life out-doors; dry place of residence; good food, air and clothing.

Nichols.—Active exercise in the open air; and all the means that have a tendency to develop and strengthen the physical powers.

Spofford.—Anything that preserves the general health. Be careful about colds, fevers, measles, coughs, &c.

Soule.—Change of location, in my opinion, has done more to prevent consumption in children of consumptive parents, than all other means combined. In all the cases of consumption occurring in Winthrop * since I have lived here, the disease came with the patient from other places; and in some instances, the patient has been very much benefited by the change, and I am by no means prepared to say that an earlier change of location would not have resulted in a complete recovery.

Stone.—Removal to another and healthy location; living, as much as possible, in the open air; sufficient out-door exercise; liberal diet, and general hygienic measures.

* It will be remembered that Winthrop enjoys an almost insular climate, being a peninsular promontory projecting far out into Massachusetts Bay.—H. I. B.

I draw especial attention to the remarks on ill-ventilated apartments in the following letters :—

Parker.—The principles of hygiene are especially to be attended to—cleanliness, warm clothing, good, nourishing food, well-ventilated apartments, a plenty of out-door, fair exercise of body and mind, but neither overtasked. A very frequent and powerful cause in developing, if not in actually causing, consumption, is, in my opinion, a contracted, ill-ventilated sleeping-apartment.

Burr.—By placing children under the most favorable hygienic influences; regulating their course of study, hours of play, diet and sleep, their sleeping-apartments. We must see that their rooms are well-ventilated, and that proper attention be given to dress. We should insist upon such children wearing three grades of flannel under-garments during the year,—*very thick* during the winter months, *medium* in spring and fall, and a *thin* grade during the summer, after the middle of June.

Calkins.—Dry and pure air, in *well-ventilated* buildings; nutritious food and ample clothing; out-door life; attention to the slightest attacks of indigestion; and by the use of those medicines best suited to the promotion of digestion and assimilation.

Shaw.—All those agencies which tend to elevate the vitality, as pure air, especially at night; cleanliness; a non-conductor next the skin; sunlight; plenty of nutritious food, especially lean meats and milk; and a chance to get into *clean dirt* in the country.

Heath.—Generous diet, warm clothing, pure air, and continued exercise in the open air, have apparently made a strong and healthy boy of my own child, whose mother had hemorrhage from the lungs during gestation, and died of tubercular consumption two and a half years after confinement.

Dwight.—In my judgment the disease may be prevented frequently, although perhaps not always, by attention to diet, exercise in open air, sunlight, and judicious clothing.

Breed.—Removal from crowded tenements in cities, to open air on Western farms. Ten or twelve examples.

Brown.—Principally inunction and attention to diet. Different oils have been used in my practice, generally olive-oil, oil of sweet almonds, or goose-oil. Particular attention has also been directed to the ventilation of sleeping-apartments, and warm clothing for the lower extremities.

Field.—Exercise out of doors; the breathing of pure air, day and night; wholesome food; and having a good time generally. Re-breathed air, in the young and old, lays the foundation of consumption more than any other cause.

Ward.—In answer to No. 3, I have written "No." In explanation, I wish to say I know of no *special means* by which to avert such result. Still I have

great faith in *general means*, i. e., the strict avoidance of all depressing influence, and the use of all available means of improving the general health and strength. This rule, I believe, should be borne in mind in all the stages of the disease, as a *preventive*, and also as a *cure*. I believe the disease to be one of debility, and promoted by every means or agency which induces debility. I judge this to be the explanation of the very rapid development of the disease after continued fevers, especially in persons predisposed to tubercular disease. I believe that this one principle, if generally practised, would save many cases (of all ages and conditions) now lost. I am very sure that tonics are the only appropriate treatment (iron especially) for all cases of consumptive disease. I base this opinion upon a pretty extensive use of the preparations of iron, and the results, as compared with any other plan I have yet heard of. Expectorants, although sometimes necessary, should not be relied upon, as is the case with too many, both in and out of the profession.

Scammell.—I know of no method of preventing consumption, except by that *kind of diet* and *mode of life* which, in each individual case, is best adapted to *promote vigor* and *increase tone.* I have seen cases where consumption was evidently *delayed* in its progress by such means, and I have no doubt it may be sometimes *prevented* in those hereditarily disposed. I suppose Dr. Bowditch remembers the case in the Massachusetts General Hospital, exhibited and described to the class by Dr. Jacob Bigelow, when I attended lectures, nearly thirty years since. The man was sixty years old, and had been in consumption forty years. During that long period the disease had been kept at bay by the patient's pursuit of *mackerel-fishing*, which agreed with him. Of course, the particular mode of life should differ in different cases.

Haskell.—I think the proportion of fatal cases much less at the present day than they were forty years ago, when I began practice, owing, I think, in a great measure, to the mode of treatment. *Then* it was customary, hereabouts, to use a spare diet and depleting medicines; *now*, nutritious food and stimulants. It does not confine itself to any trade or occupation.

Reynolds.—I suppose you wish opinions founded on observation. I have not known consumption apparently prevented in children hereditarily disposed to it, because I have never known means used purposely in due season. I think it might be often prevented by life in the open air, or by a change of climate, *before the disease was developed.* Such means are rarely resorted to until after symptoms are manifested. A sea-faring life, a life in the army, an agricultural life, especially in a climate little subject to change, are doubtless among the best means of prevention. Compression of the chest, in females, not only injures them and their female offspring, but their male offspring as well. Females with any tendency to consumption should avoid all compression of the chest from earliest childhood.

Downes.—While some of the medical faculty of our country send their consumptive patients to the West Indies, while other physicians send their patients to Russia, it will be well to suspend judgment until sufficient data are furnished. It would seem, however, that *in medias res* would be the most judicious. I have no doubt but that moderate out-of-door exercise in a dry, exhilarating atmosphere, like Minnesota, is of more advantage than medicine.

Rice.—I know of no positive means of preventing consumption in children who have inherited a scrofulous taint from their progenitors. Every means to invigorate the general health should be used,—such as a generous diet, pure air, exercise in the open air, warm clothing in winter, dwelling in a high and dry altitude, and, perhaps, the administration of iodine and iron. Also, the patient should not be made to study or occupy the mind in a degree to produce lassitude. I think the constitution can thus be somewhat modified, and perhaps, in some cases, the scrofulous taint completely annihilated.

French.—Children should be kept, if possible, from the contagion of the exanthemata (measles, scarlet fever, &c.), should always be dressed in flannel, take the open air, and as much sunshine as possible; the feet should always be kept dry. If they have eruptions, great care should be used in applying ointments and washes; it is apt to transfer it to the head or lungs. They should practise temperance in all things.

Smith.—I would answer, first, a selection of a mild, dry and healthy climate; second, constant exercise in the open air (I mean a vigorous, free exercise); third, a highly nutritious food, avoiding pork; fourth, daily application of cold water to the skin, with friction; fifth, the cultivation of a cheerful and happy disposition; sixth, avoidance of all excesses. In this section, atmospheric vicissitudes are the most exciting causes. I have seen many caused by syphilis.

Fiske.—It has been my opinion that a person predisposed to consumption by hereditary taint, &c., might do much to ward off, or entirely to avoid it, by being well clothed, and taking that kind of exercise, out of doors, which would invigorate the system; and, at night, by sleeping in a dry locality, away from water or low, marshy ground.

Winsor.—Regular and interesting exercise in the open air, and free admittance of fresh air to the dwelling; a regular, easy (but not indolent) life, with cheerful and congenial social relations; plenty of sleep, and of nourishing and palatable food; animal warmth maintained more by clothing, and less by heating apparatus, than is customary.

Barker.—By avoiding the common causes, and pursuing a hygienic course; by taking active exercise; by occupation; by being much in the open air; and by attending to the first appearance of the disease with appropriate medication.

Collamore.—I think consumption is prevented in those predisposed to it in some cases, but it is difficult to say how, unless we say, in general terms, by the use of means which conduce to general healthfulness. Hon. and Rev. M. A., called by Mr. Webster "the model farmer of Plymouth County," who died a year since at the advanced age of ninety-four years, was troubled with hæmoptysis when a young man, and was thought to have had diseased lungs. I do not know that any special means were employed in his case, but I do know that during his long life he was a model of propriety in eating, drinking and exercise; that he avoided excitement and late hours. I have in mind now a young lady whose life is being prolonged by removal to Minnesota. She is very strongly predisposed, and the disease had commenced before her removal, two years ago, but is now stayed. There seems to be a period, from sixteen to twenty-five, or thereabouts, that seems to be a critical one.

If by any means the person is wafted over this period his immunity is very much enhanced. About a year since I lost a patient, the last one of seven children, all of which, with one exception, had died with consumption. She was the only one that I had attended. The others had died in different places, but all young. Two of the others, as well as she, had borne children. In her case I think I kept the disease in check for more than a year, by the use of Savory and Moore's Pancreatic Emulsion. The old homestead is in a dry location.

Miner.—I have in mind one case where the hereditary predisposition was very great, the subject being Dr. A. M. O., of H———, whose mother, two or three sisters, and a brother, died of it, and who had hemorrhage from his lungs, followed by pneumonia, about twenty years ago. He took cod-liver oil very freely, and some stimulants, after his recovery from the pneumonia for two or three years, and kept at the practice of his profession, over high hills and rough roads, and *always at it;* I might almost say day and night. He is now strong and well, and nearly fifty years of age. I have thought that his business, keeping him so much in the open air, and the oil and generous diet, with the care he has always taken to keep himself well protected by warm clothing at night and when the weather was severe, have been the means of warding it off. I have other cases of a similar character, and where the same medication and *exercise in the open air*, especially *horseback-riding*, have done much to prevent what otherwise seemed incurable. I have more faith in horseback-riding than in any other form of out-door exercise.

Wilcox.—Such means as are calculated to promote general health, and especially, a good appetite. I have a case under observation for the past year, in which there was positive evidence of tuberculosis developed in the upper portion of the right lung, in which there has been most marked improvement, though I will not yet say it is *perfectly cured* (a boy now sixteen years of age); by taking him out of school; by daily out-door exposure (except in the most inclement weather), and by making it a point that this exposure should, whether as an occupation or recreation have an object aside from the fact of its being for health. Added to this, he has taken, during the year, three bottles of Nichols' sirup of the hypophosphites of lime, soda, potash and iron.

Metcalf.—I think a permanent residence in a warmer climate, before the development, to any extent, of tubercle, has apparently prevented the occurrence of consumption in children hereditarily disposed. In a family in this town, of six children, all but one died of consumption, before arriving at middle life. He removed to New Orleans, and has constantly, except an occasional visit to New England, remained in the States of Louisiana and Mississippi. He has always enjoyed good health and never had any pulmonary troubles. I know "one swallow does not make it summer," but you will take my case for what it is worth.

Knight.—Clothing, diet, exercise; also, elevated location, with soft water.

Wilmarth.—The special means for prevention, I should divide under three heads; viz., *diet, clothing and hygienic influences.* We frequently find that children hereditarily disposed to consumption are undeveloped, physically; while the nervous system is unduly active, showing a precocity. This con-

dition, if encouraged or allowed to continue, undermines the constitution, and impoverishes the health, by using the material through nervous activity, that should go to the growth of the body. A *diet* for such condition should supply the waste and build up the body. The supply of waste will best be accomplished by the articles containing more or less phosphorus, such as wheat (not flour), beans, fish, &c.; while the growth of the body requires, in addition to these, the albuminous, carbonaceous and fibrinous compounds such as we find in meat, eggs, milk, corn and vegetables. In choosing a diet, reference should be had to the condition of the bowels, which we often find in a constipated state. This should not be allowed, without a persistent, constant and untiring effort to overcome it. Avoid pastry and food that can be swallowed whole. Choose the food that will need *chewing*, and *chew it thoroughly*. Take plenty of time to eat, and eat at regular intervals. Fruit and berries may be used with the meals to advantage, the acidity of them moistening the fecal matter; and the small seed and skin promoting the peristaltic action of the bowels. Avoid much drink with meals, as it tends to wash down the food before it is properly masticated. Let supper be the lightest meal of the day, so that the stomach will not be obliged to work during sleep. Encourage the habit of daily evacuation. Perseverance in these matters will usually overcome the constipated habit, if other hygienic measures are brought to bear at the same time. Cathartics should *not* be depended upon to relieve the condition; they are only temporary in their action.

The *clothing* should be neither burdensome nor scanty, but should be both light and warm. It should not be a ready conductor of heat, thereby causing the wearer to feel changes of temperature unpleasantly. Light woollen garments are more comfortable to the wearer, in this respect, than cotton, and I think, more conducive to health. Protect the extremities. Tight-fitting garments are neither comfortable nor healthful, and tight-lacing about the chest is positively injurious and ought to be discarded. Too much dressing about the neck is as injurious as too little. The practice of constantly wearing a hairy fur or woollen tippet, keeps the neck in a state of perspiration, and a person is thus always liable to take a cold,—to settle in the throat and produce irritation, with cough. *Hygienic influences.*—Under this head I would include *air*, *exercise*, *sleep*, restraint of injurious tendencies and the promotion of a healthy physical growth. The *air* should be pure, free from the influences of low lands or stagnant water, or impurities of decaying animal or vegetable substances; and it should be what is called a dry atmosphere. Such an air should be breathed freely, out of doors. Exercise, such as the system will bear without undue fatigue, should be taken *every day*. Special attention should be given to the healthy growth and enlargement of the chest and of the muscular system generally. A judicious use of calisthenic exercises would be very beneficial. *Sleep* should be encouraged in the *early part of the night*. If children are kept up late, it is at the expense of the nervous system, and the morning sleep does not fully compensate for the loss. *Occupation* of such children, until they are seven or eight years old, should be very light, mentally, with just enough physical employment to keep them out of mischief. It is better that they should not go to school before this age, and when they do go, the mental effort should be restricted to the physical capacity. I do not mean by this, to encourage habits of laziness, but to avoid what is too often the case, *pushing* a forward child. In choosing an occupation for after-life, one should be taken that avoids sedentary habits or close confinement. Trades where fine dust is a

necessary attendant, should be avoided. *Injurious tendencies* are those which in any way weaken the constitution; such as overwork, overstudy, too much play, excess of any kind, frequent or continued excitement. Anything which calls for an outlay of nervous force more than is conducive to health, should be restrained. Work, study, play and the excitement necessarily attending them, are healthful and needed to properly develop the system, and should be encouraged with alternations of rest, so that a healthy reaction, not an exhaustive fatigue, may follow.

Gilbert.—A healthy location; proper food, clothing and exercise; and regular habits.

Parsons.—Diet, climate and voluntary expansion of chest.

Rice.—I know of no means of preventing it, in children of consumptive progenitors; or, at least, no means other than those used to invigorate the general health.

Wakefield.—Children who are clad in flannel; fed upon beef, mutton, etc., instead of pork; well guarded against sudden changes in temperature, may apparently, escape tuberculosis. An exciting cause, e. g. pneumonia, may develop the latent disease.

Hammond.—The special means of preventing the disease in children, are those which tend to produce a healthy and vigorous action of all the organs of the body. This can be done by proper exercise, taken when the body is not exposed to any improper state of the atmosphere, either of cold or dampness. Exercise in the open air, when the temperature is too low, or when there is much dampness, is not proper. The condition of the system when the person takes the exercise, should be taken into account. If the system is exhausted, in a measure, the exercise should be performed with caution. The clothing should be suited to the season; the diet nutritious. In fact, whatever tends to render the system active and vigorous, also tends to protect the body from all predisposition to disease.

Haskell, of S., Me., says (communication received too late to be used in the general analysis),—

a. By good nourishing food, largely animal.

b. By abstaining from alcohol and tobacco, especially the latter.

c. By abstaining from inordinate indulgence of animal appetites.

d. By the use of flannels, (if in New England) the year round, to chest, legs, and arms.

e. By residence in a dry climate, of high latitude.

f. By leaving home, and the cares of home, once or twice in a year, especially if they go from "the shore," inland.

This last clause (*f*) applies, in my experience, grandly, in the treatment of consumption. By this course, and by the use of clams, oysters, fish, etc., and cod-liver oil, and porter, whiskey and hot flax-seed tea, etc., with an inhalant mixture, life has been made more comfortable and prolonged.

Abell.—To prevent the development of the disease in children, there should be extra care in guarding against exposure to wet, and chills, by attention to clothing; by using plentiful nutrition; and by keeping the

digestive system in good order; rather than by any specific drugs; and by encouraging exercise in the open air, in such systematic ways as would develop muscle, and expand all the air-cells of the lungs, thereby leaving as little soil as possible, for the development of the causes of tubercle; but that any means would entirely prevent the development of those causes, occurring at, or before birth, I am not so positive. I have examined the lungs of infants, dying with other diseases, at the ages of four or six months, whose lungs were studded throughout with minute tubercles. I think change of climate might effect a good deal, in preventing tubercular development, as I have known severe cases to recover, after two years' residence in Minnesota—both first and second stages—though I think the benefits claimed by residing in Minnesota, overrated—but I know many families who were apparently predisposed to consumption while living in New England, whose children almost *never* had phthisis developed in Minnesota. There is certainly quite a difference in the atmosphere, in some way, as I found I could myself bear twice the exposure, in Minnesota as in New England, without taking cold. My wife, also, who has been severely attacked with "hay-fever," * for the last fifteen years, (beginning in the latter part of August, and lasting from six weeks to three months,) whenever she visits Minnesota, escapes the attack invariably, and breathes as freely as anybody. On returning to Massachusetts the attack comes on again. She tried this experiment three times, with the same result.

Luce.—In a family of seven, four boys and three girls, all the girls and two of the boys died of consumption, under the age of twenty-five. The two remaining boys were the youngest of the family; the eldest of these began to manifest symptoms of the disease, and embarked for California, where he recovered, and is now strong and healthy. The youngest is still at home, but in feeble health. The father of this family, is a farmer and fisherman, and is now seventy-two, hale and sound; the mother sprung from a consumptive family, and died in middle life.

Butler.—By attention to diet and general habits of life; by change of location and climate, if one or both should seem to promote the disease; outdoor exercise, such as shall tend to expand the chest, and give full, free play to the lungs.

Hartwell.—The especial means to be used for the prevention of consumption in children hereditarily disposed, besides a strict observation of all hygienic laws, are, *if the mother is affected*, the employment of a healthy nurse who shall have the whole care of the child, or, if one cannot be obtained, a healthy woman, who shall feed the child with cow's milk, properly diluted. When milk, drawn from one cow, well-known to the family, is not to be had, Comstock's Food, (Liebig's formula) has been used by me, in two cases, and both thrived remarkably well. *If the father is affected*, the mother may nurse the child, but ought not to have the father under her charge or care, at the same time. Second, and as important, I think, is the separation of parent

* "Catarrhus Autumnalis" would be, I think, the more correct term, according to the recent admirable researches of Dr. Morrill Wyman, on that very distressing malady.

Autumnal Catarrh (Hay-Fever), with three maps, by Morrill Wyman, M. D., late Hersey Professor of the Theory and Practice of Medicine in Harvard University. New York: Hurd and Houghton. Riverside Press. Cambridge, 1872.

and child. (I cannot say that I think we are warranted in making the separation forcible.) If proper ventilation could be enforced, occupying the same house would not be objectionable; but that is almost impossible. This applies to children also, and some of the difficulties are removed. Of course, the various tonic remedies are not to be omitted, of which the best is cod-liver oil, if any tendency to emaciation exists.

Holmes.—Warm flannel clothing; fresh meat, butter, milk and eggs, diet; out-of-door exercise in high and dry location; with pure air, erect position, with free and full expansion of the chest, are among the best means of prevention.

Hills.—A case of mine had Pott's Disease, and while under treatment pulmonary tuberculosis was developed. I do not think an abscess of the vertebra opened into the pulmonary tissue, although the child previously had an abscess which pointed a little anterior to the large trochanter. The child wasted quite rapidly, had severe cough, and profuse expectoration of thick grayish and yellowish sputa. The child took iodide of lime, and, some of the time, a sirup of the hypophosphites, but most of the time cod-liver oil and some expectorant. In the spring and early summer he began to improve, and by fall was quite fat and hearty; cough continued, but less severe. Improvement lasted, without relapse, until April, 1871, when the child was taken with diphtheritic croup, and died after two days' illness. In this case I think the tuberculous symptoms were evidently abated, and I was led to hope for complete recovery, had the patient not died of another disease. And here I will state that this child took exercise in the open air whenever the weather permitted it; also ate largely of sugar, and I think, drank milk freely. At the time of death it was four years seven and a half months old.

A case came to my knowledge where the mother died of consumption soon after the birth of a daughter. I do not know that that child had any appearance of disease, but the father determined she should have a chance to be robust, so he had the child well and warmly clad, thoroughly protected from the vicissitudes of the weather, and then sent her forth, at all times, and in all kinds of weather. At the present time (unless recently indisposed), the young lady (of seventeen, I presume) is, to all appearance, in perfect health. I cannot answer whether consumption will assail her in later years, but it is my opinion that without the physical training she went through, she would now be suffering from incipient phthisis.

Harlow.—I desire to instance a family consisting of father, mother and four children, two males and two females, in which the parents both died of phthisis fifteen years since. The children were supposed to inherit the tendency to tuberculosis, were separated, placed in good families, locality changed, regular systematic hygienic rules were enforced in each case. All have arrived at mature age and are now in robust health, though one of the girls gave signs of incipient pulmonary trouble nearly three years since, which soon disappeared upon making a radical change in her mode of life, viz., removing her from school and keeping her much out of doors.

Call.—Change of climate and change of associations are among the best preventives of the disease in question.

Aiken.—The best hygienic conditions, such as in infancy, "plenty of milk, plenty of sleep, plenty of flannel!" Later, a country life, especially in the

summer; plain, but nourishing food, brown bread or its equivalent at least once a day; regular habits generally.

Haynes.—Diet; exercise; location; judicious use of such articles of food and drink as will promote the development of bone and muscle.

Spalding.—No specifics, but such general treatment as will promote sound physical health.

Carbee.—First, attention to diet; second, avoid exposure, either riding or driving, in open air; third, administration of suitable tonics whenever indicated.

Bullard.—Removal from consumptive family; out-door employment and nourishing diet; also removal to another State, as going West.

Carr.—Temperance, air, exercise in open air, avoiding all manner of debilitating practices of body or mind, favorable location, etc.

McCollom.—Out-door exercise, sleeping-apartments well ventilated, plain, nutritious diet, cleanliness, proper clothing, eight or ten hours' sleep.

Fairman.—Large, well-ventilated sleeping-apartments, plenty of exercise in open air, journeying, especially on horseback, good, wholesome diet, freedom from care, attention to the general health, avoidance of cold, wet, damp, and exposed localities.

Ranney.—I am sorry to say, after a practice of twenty-five years, and observing cases treated and not treated, that answers to your questions must mainly be conjectural, and, consequently, of little value. The conclusion to which I have come is this: tuberculosis results from a peculiarly depraved condition of the system, generally hereditary. If otherwise, and the predisposition not transmitted, there is not sufficient evidence to establish proof of *cause.* Until the cause is ascertained, the way of prevention or promotion seems to me very *dark* and *blind.* Conclusion,—a glorious uncertainty about the whole matter contained in the questions.

Richmond.—Free, timely, and proper exercise in a pure atmosphere. Special attention should be paid to the digestive organs, or blood-making machinery, that the greatest possible amount of good, wholesome food may be converted into blood; and all condiments (stimulating) be avoided. *Tobacco, the greatest bane to human kind,* from its enervating power, is to be avoided in every form *by all means.* *Porter,* more than any article in my practice, prepares the digestive organs for nourishment, and guards the system against tuberculosis.

Mayo.—Change of climate.

Bolan.—I think cod-liver oil, with a constant and small dose of liquor, will retard the disease, and at times, produce a cure. I have seen a few children recover when one lung was entirely diseased.

Lincoln.—Let the child, in infancy, receive its nourishment from a healthy nurse, free from any hereditary taint; a strict attention to cleanliness, keep in a moderate temperature, a sufficient quantity of clothing, pure air and sunlight. Let it sleep with a healthy, but not old, person. In childhood give it healthful, but not too violent exercise, so as not to prostrate those weak powers, but rather to invigorate and strengthen. If the patient is in a state of perspiration do not check it too suddenly. The brain should not be overtasked while the physical powers are weak. There should be an entire abstinence from any of those indulgencies which are so antagonistic to nature. It is our conviction that, by a strict adherence to these prophylactics, there is a possible escape from the terrible scourge which cuts down so many of the human race.

Sanborn.—Moderate exercise daily, regular habits, such as regularity in eating, drinking, sleeping, and attending to calls of nature, dressing properly, not wearing clothes so close as to punish and disfigure the person, amusements, generous diet, change of location or climate, and keeping in the open air as much as possible when the weather is suitable. A change of climate I consider almost absolutely necessary, and, in the majority of cases, indispensable. Also amusements,—everything which tends to cheerfulness of a moral character.

Robbins.—1st. Residence in the country. 2d. Attention to diet: food to be taken at least four times a day, till ten years old, which is to be largely animal—especially milk; sugar not to be rejected, but largely and judiciously used, as taking the place of fat in adult life. 3d. Bathing, almost daily, with frequent change of clothing. 4th. Constant out-door life. Such children by *no means to be sent to public schools.* Body before mind. Make romps of them rather than precocious prigs.

Bromwell.—Extraordinary attention to general health.

Eldredge.—I believe consumption to be decidedly hereditary, and that where there is this tendency life may be prolonged by generous living, residing in a favorable locality, having regard to drainage and exposure rather than to temperature; always sleeping in an upper chamber; and by avoiding harassing care and hard labor of every kind.

Collins.—Good air, food, residence, surroundings, and everything that goes to make a perfect animal.

Peaslee.—Hygienic means, especially out-of-door occupation.

Condie.—I have seen cases in which children, male and female, strongly predisposed by hereditary taint to tubercular phthisis, have had the disease arrested, or, more properly speaking, have been saved from a development of the disease, by a proper hygienic course of treatment, including diet and regimen, especially when pursued in conjunction with a complete change of climate—from one marked by dampness and rapid transition of temperature to an elevated, dry, inland situation with an equable temperature. Even in adult life, I have known pulmonary tuberculosis, after it was actually com-

menced, arrested in its course by the above means. In one instance—that of a man named K——, some thirty-eight years of age—a saddler by trade, laboring under tuberculization of the lungs, at my advice, changed his occupation to that of drayman. This calling he pursued unintermittently for about six years, and affected an *entire cure*, as, after a very close examination, I verily believe to be the case.

Murchison.—Good nourishment, and removal to a *dry* climate of equable temperature. Since I had the pleasure of meeting Dr. Bowditch in London, more than fifteen years ago, when he demonstrated his views to a meeting of the London Medical Society of Observation, held at my house, I have been satisfied of their soundness, and for many years I have taught them annually in my lectures.

Plimpton.—Dry locality and fat meat.

Bennet.—Hygiene, and country life.

Snow.—Warm clothing, especially of the chest, arms, legs, and feet, in infancy, childhood and early youth, particularly in females; good food; a large amount of out-door exercise; little brain-labor before fourteen years of age; a general observance of the laws of health, and no "dosing."

Blanchard.—By keeping the digestive and assimilative organs in a healthy condition, and avoiding those causes which produce a certain inflammatory condition of the lung tissue, which *almost* invariably results in the deposition of tubercle.

Smith.—(*a*) Proper food, which should consist largely of milk; as the proportion of milk is diminished, animal fats must be taken in other forms; also vegetable oils, in the form of nuts. Beef, mutton, fowl and fish, so varied as always to be relished. Fruit and vegetables, in variety and abundance. *Unbolted cereals* in proper quantities. (*b*) Proper clothing, with particular attention to the temperature of the extremities, both sleeping and waking. (*c*) Sufficient opportunity for sunlight and fresh air, with exercise. (*d*) Plenty of sleep, in large, dry, and well-ventilated apartments. (*e*) Avoidance of excitement, fatigue, and exposure to any depressing influences. (*f*) When the child is well fed and cared for in other matters of hygiene, there is little to be done in the way of medication; but I have thought that the Tr. Ferri Chloridi, largely diluted with the sirup of sugar, and taken after the meals, for a period of one or two weeks at a time, with like intervals, one of the best medicinal agents to use.

Fisher.—Frequent change of residence; selection of healthy locations on dry, porous soil; in unshaded houses; sleeping apartments ample, *well ventilated*, in second or third story, admitting sunlight freely; with the greater part of daylight spent in the open air; in moderate and judicious exercise; and with the observance of the well-established hygienic laws, as regards clothing, diet, mental emotions, &c. An observation of twenty years gives

me the fullest conviction that quite a number whom I have now in mind, and who at this time are enjoying tolerable, if not robust, health, would have long ago filled consumptives' graves, but for precautionary measures, including those enumerated above, which, by advice, they have observed in a greater or less degree. Some of these had only strong predisposition; others had actual tubercular deposition, with all the usual symptoms of incipient phthisis, lasting from three to fifteen months, and having added, in the latter number, the physical condition of confirmed consumption. I must admit, however, that some cases which seemed as favorable for recovery as these now living, and observing the same hygienic influences, have succumbed within two or three years from the first attack. Nevertheless, I have not the slightest doubt that a great number may be saved.

Howe.—First of all, the hygiene of the system claims our attention. This is mainly comprised in four things—clothing, rest, exercise and diet. The person should wear flannels next the skin, throughout; he should observe perfect regularity with regard to the remaining three; should retire and rise early; should take plenty of exercise in the open air, always remembering to be suitably clad.

An out-door employment should always be preferred for one having a tuberculous diathesis. The diet should be thoroughly substantial, nutritious, and easily digestible. Excess in eating, as in exercise, should be avoided.

The above, I consider first in importance; but secondly, what can we do by way of medication?

Cod-liver oil has proved more efficacious in my hands than all else. I can refer to cases which presented marked symptoms of tuberculosis, which came up, under its *persevering* use. By *persevering,* I mean six, twelve, eighteen months, or more. Many fail in obtaining the desired effect because they do not continue the remedy long enough.

Fourth Question.

This question, and the subsequent ones, up to and including number eight, were suggested in order to meet the absorbing interest which we all have in the terrible evil of intemperance. Doubtless, in the estimation of many readers, some of these questions may seem useless, or perhaps absurd; and the results may seem equally futile, in the estimation of others. But, as I consulted brevity, in order to get any answers, I hope that all captious indifference, or opposition, will rest while we try to arrive at some results, however small, towards the elucidation of this subject of such importance to the future health, morality and intellect of the people of Massachusetts.

Is Consumption caused, or promoted, by the Drunkenness of Parents?

The documents allow of the following table :—

	Yes.	Yes; by depriving children of comforts, &c.	No.	Doubtful.	No reply.	Totals.
In Massachusetts, .	63	3	33	18	26	143
Outside of Massachusetts, ...	37	6	11	1	12	67
	100	9	44	19	38	210

I confess to a feeling of surprise when considering this table. I had supposed that medical opinion would be more unanimous in its condemnation of intemperance in parents, because of its effect upon the offspring, and its tendency to cause consumption. But it would seem that drunkenness, amid the many horrors that it entails upon the offspring, does not, in the minds of a great many of the profession, tend to cause consumption. Out of our two hundred and ten correspondents, only one hundred and nine (51.43 per cent.) answer in the affirmative, viz., that they believe drunken parents bring consumption upon the children. One hundred and one (48.09 per cent.), on the contrary, take either the negative, or are doubtful, or decline to answer.

There is another rather curious result of the above table which, as prepared, shows the number of correspondents in and out of the State. It is this, viz. : that in Massachusetts there is less belief in the power of intoxication to cause the begetting and rearing of consumptive children than there is out of the State. This is shown by the different proportions of affirmative answers, in the two, viz.: 64.18 per cent. of those outside of the State, to 46.15 per cent. from Massachusetts. Moreover, there seems less doubt about the question, among physicians outside, than among those resident within the State. We cannot, of course, draw positive conclusions from such small numbers. Nevertheless, this seems to me a singular result, when I remember that here in Massachusetts,

discussion on the evil results of intemperance have been going on for so many years; and, in which State, therefore, one must believe that the results of intemperance must have been brought to the notice of the profession and the public as much, at least, as elsewhere.

Extracts from Correspondents' letters upon this question.

Reynolds.—Yes, by producing feeble offspring.

Hammond.—Drunkenness of parents deprives children of the comforts of life—often, of proper covering for their bodies, of proper food, or lodging. and thus their vital energies are exhausted, and any disease is liable to develop itself.

Jordan.—I have never seen a parent who drank to excess who did not have consumptive children.

Hunt.—A drunken parentage is a cause.

Fiske.—No, no further than surrounding circumstances bear upon the case.

Dwight.—Sometimes, by neglect and bad food.

Gavin.—Yes, especially when the *mother* is a drunkard.

Holmes.—No, except by the neglect it causes.

Richmond.—Some cases may be found where poverty may cause too close confinement and a lack of suitable nourishment, where it may be a cause.

Harris.—By defective organization and impaired vitality.

Fisher.—I cannot say I have known cases where drunkenness has *directly* caused consumption by the effects of liquor on the system. Cases of phthisis occurring in the progeny of drunkards are so constantly preceded by poverty, neglect, exposure and violations of the laws of health that it would be difficult to determine what agency drunkenness had in causation, otherwise than in producing the circumstances under which they occurred. In a few cases the children of drunkards, or of those addicted to the excessive use of ardent spirits, without positive intoxication, and in comfortable circumstances, I have been able to satisfy myself that the disease was due to other causes.

Fifth Question.

Is Consumption caused or promoted by the drunkenness of an individual?

On this question there seems a great diversity of opinion. The table is as follows:—

	Yes.	Yes; as secondary to gastric, etc., troubles.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts,	71	5	30	13	24	143
Out of "	38	3	17	–	9	67
	109	8	47	13	33	210

Thirty-three (15.71 per cent.) decline to answer the question; thirteen (6.19 per cent.) are doubtful; forty-seven (22.38 per cent.) say "no," while one hundred and nine (51.90 per cent.) of the two hundred and ten correspondents answer decidedly in the affirmative, and eight say that the disease occurs in consequence of the disturbance caused in the stomach and digestion by the beastly habit of intemperance.

The question, undoubtedly, is a difficult one; meanwhile, it cannot be said that medical opinion, as tested by this correspondence, sustains the idea that consumption necessarily is caused or promoted by intemperance in the use of alcohol. Meanwhile, some very singular coincidences, to say the least, arise, in which consumptive tendencies seem to disappear with a really intemperate use of liquor, a reference to some of which will be found under next question.

Extracts from Correspondents' letters upon this question.

Burr.—In cases of consumption in the intemperate, probably drunkenness was the secondary cause.

Parker.—In all cases of tubercular consumption of the lungs in drunkards, which I can now recollect, that disease seemed to be developed secondarily to disease of the liver, or stomach, or both.

Winsor.—When superintendent at Rainsford Quarantine Hospital I had quite a number of cases of phthisis in the wards, where the habits were drunken, and where it could not be doubted that the disease advanced faster on this account. But there was scarcely one not acted on when out of hospital, by all manner of other depressing and warping conditions, so that it would have been impossible to separate and analyze the parts played by each in developing and advancing the disease.

Barker.—Bronchial consumption sometimes takes place when the general strength and digestive system are broken down by drinking.

Hills.—I have a patient now, in whom I believe phthisis has been promoted by the excessive use of intoxicating drinks. This case seems to be ameliorated by the use of cod-liver oil, two parts, and Tinct. Cinchona Co., one part, (the dose being one tablespoonful,) but whether the disease will be arrested remains to be seen. An expectorant also is being used in this case, but no stimulant other than the cinchona.*

Wakefield.—I had a patient several years since, a soldier in the Mexican war, very dissolute. I treated him for fractured patella and mania a potu at the same time. He was an habitual drunkard. He finally had a severe attack of hæmoptysis, and died of rapid consumption. This, I think, might have been prevented by sobriety and good food.

Hunt.—In my judgment the most potent causes are the drinking customs of the community, and the prevalent use of intoxicating liquors as beverages.

Clary.—I cannot give an opinion respecting the influence of alcohol, except that I believe that all depressing influences, whether physical or moral, tend to its development, drunkenness amongst the rest.

Watson.—I do not recollect an instance of consumption in an habitual drunkard.

Palmer.—Yes; by inducing inflammation.

Sixth Question.

Is Consumption prevented by the drunkenness of an individual? In other words, Is a drunkard less liable than others to Consumption?

On this question we have sufficiently curious results. The tabular statement is as follows :—

	Yes.	In some cases checked or retarded.	No.	Doubtful.	Unanswered.	Totals.
Reports from Massachusetts, . .	21	3	72	16	31	143
Reports from other places, . . .	6	4	41	1	15	67
	27	7	113	17	46	210

Forty-six (21.90 per cent.) decline to answer; seventeen (8.09 per cent.) doubt; one hundred and thirteen (53.80 per

* But this cinchona tincture is medicated alcohol.

cent.) answer in the negative; whereas twenty-seven (12.86 per cent.) answer "Yes," and seven (3.00 per cent.) say that consumption is retarded.

In the present state of public opinion in regard to the use of intoxicating drink it requires some moral courage to say anything in favor of alcohol. To declare that it sometimes seems to save the drunkard from the consumption to which he is hereditarily predisposed, requires not only moral courage, but a sincere conviction of the truth of the assertion made. The fact, also, that only a little more than one-half (53.80 per cent.) declare that the disease is not prevented by drunkenness is a small proportion, provided the profession generally hold that the opposite opinion is the correct one.

Meanwhile there have been some very peculiar examples in certain families, which seem to indicate that intemperance, bad as it is at any time, does nevertheless in certain cases apparently have some good effect in warding off consumption, for in these instances the only persons that have escaped out of entire families were the one or two who indulged inordinately in the use of spirituous liquors.

Perhaps one of the most curious documents supporting the idea that intoxication with ardent spirits tends at times to prevent consumption may be found in the letter from Theodore Parker to the chairman of the Board, written in 1858, in which he gives details of his own family history. Mr. Parker had no doubts about the matter, and in that letter expresses the belief that "intemperate habits (where a man drinks a pure, though coarse and fiery liquor, like New England rum) tend to check the consumptive tendency, though the drunkard who escapes may transmit the fatal seed to his children." * I will add that I have no doubt that, by the wretched constitution the drunkard usually entails upon his offspring, that seed is much more likely to spring into life than in the robust begetting of the temperate and healthy.

It is evident that the question is still a debatable one, to be decided by a more careful study of more facts.

* Appendix, page 515, vol. 2, "Life and Correspondence of Theodore Parker," by John Weiss; New York, 1864.

Extracts from Correspondents' letters on this subject.

Smith.—Think I have seen life prolonged by it; no definite facts.

Spofford.—They, i. e. drunkards, sometimes live to old age.

Reynolds.—Father and some children died of phthisis. Three sons became "free livers," and still live, strong and stout.

Parker.—Yes; by moderate use of alcoholic stimulants; not to the extent of drunkenness.

The following is a very significant, if sad, case:—

Blodgett.—I have in mind an individual who seems to have warded off tuberculosis by a long-continued debauch. There seems to have been a cessation of tubercular activity from that time onward. When the individual, by virtue of his inherent manhood, ceases for a time to use alcoholics, tubercular activity sets in. The connection between the two seems in this instance to be certain.

Gilbert.—The progress of some cases may be checked by the moderate use of stimulants.

French.—From an experience of twenty-six years, I do not believe that alcohol causes or prevents consumption. This disease has been diminishing in this part of the State, especially in Warwick and Royalston, Mass., Richmond and Winchester, N. H., towns in which I have practised more or less for the past twenty years, and in that time there has been a great reformation in temperance. In Warwick, in a mortality of thirteen, for the last seven and a half months, there was but one case of consumption. It is hilly and dry; no swamps, no stagnant water, no nuisances of any kind; people remarkably temperate.

Howe.—I do not think drunkenness in itself really injurious to the consumptive; the other vices, which are usually associated with it, are. If we could have the former without the latter, alcohol might frequently be beneficial.

Butler.—Does this involve the free use of whiskey and other stimulants in the treatment of consumption? If so, I answer no; for, in my opinion, no case of consumption, hereditary in its nature, was ever cured or essentially benefited by the free use of stimulants. An unnatural excitement may be produced, which may be mistaken for returning health, but it is only awakening hope to be ultimately disappointed.

Abell.—I should be sorry to be understood as recommending drunkenness as a cure. But I have known several instances where nearly all the family, from five to nine children have successively died of phthisis. Finally, one of the boys, from sheer desperation, took to excessive drinking of alcoholic stimulants. These boys are now past middle life, and enjoying good health when last heard from. In two families, not less than five or six victims in each were carried off by consumption. In each there was always one sick, and a short time before death another would be prostrated. In one family

they resorted to that horrible relic of superstition, the burning of the heart, etc., of the *dead*, and the ashes were swallowed by the survivors, in the hope that the fatal demon would be exorcised from the family, but it did not avail. But another son fell a victim; and then the alcoholic treatment was tried, not as an expected remedy, but as a means of forgetfulness of impending doom, and no deaths in the family have to my knowledge since occurred.

Rice.—I believe the moderate use of liquors, by persons of a consumptive habit, to be a means of preventing the disease. I have known intemperate people die of consumption, but cannot say that the disease was hastened to a fatal termination by the habit.

Richmond.—There are some cases in the country where poverty might beneficially modify the diet, and compel the child to take a more active course of life, and make him more healthy than would be the case in affluence. In other words, poverty, growing out of drunkenness, might reduce the family to a plainer mode of living; compel its members to adopt a more active life; and thus improve their physical well-being, though they may be predisposed to consumption.

Carr.—Not unless one dies of drunkenness, before consumption develops itself.

McKenzie.—Very rarely is phthisis found amongst drunkards.

Smith.—Consumption is not *prevented* by drunkenness, but may be influenced beneficially, in severe cases, by a free use of spirituous and malt liquors.

Twitchell.—I know that I differ from many, but I am satisfied from my experience that I am right. I never knew a person cured or his life prolonged when in a consumption by the use of alcoholic spirits; but in several instances have known it—consumption—caused by alcohol itself, or by the effects of poverty and exposure, which are often attendant upon persons who largely indulge in alcoholic drinks.

Seventh Question.

Is Consumption prevented by total abstinence on the part of an individual? In other words, will total abstinence save a man from Consumption?

The table stands thus :—

	Yes.	Retarded.	No.	Doubtful.	Unanswered.	Totals.
Returns from Massachusetts, ...	25	1	58	19	40	143
Returns from outside of Massachusetts, . . .	13	4	31	3	16	67
	38	5	89	22	56	210

Thus we see that nearly one-half (42.38 per cent.) take the negative, viz.: that total abstinence does not prevent consumption; and ten per cent. are doubtful; 26.67 per cent. makes no reply; and only thirty-eight (18.09 per cent.) say that consumption is prevented by total abstinence.

This question, it must be admitted, is very difficult if not, strictly speaking, impossible of solution.

Nevertheless I asked it, thinking that some facts might be elicited, like the following, viz.: that in the family of some drunkard, where many have been given to intemperance, and have died of consumption, one who had practised total abstinence escaped the disease. No such case, I believe, is on record. I regret the conclusion, but think it possible that no such case has occurred. The following comparison of percentages of answers to the sixth and seventh questions, as more clearly illustrating the opinions of the profession on this subject, is interesting:—

	Yes.	Retarded.	No.	Doubt.	No answer.
Consumption apparently prevented or retarded by intoxication, ...	12.85	3.33	53.80	8.09	21.90
Consumption apparently prevented or retarded by total abstinence, ...	18.09	2.38	42.38	10.45	26.66

Extracts from Correspondents' letters on this question.

Winsor—I would answer in the affirmative if under it were to be included those persons who cannot drink without going to excess, and for whom there is no middle course between drunkenness and total abstinence.

Barber.—If a person becomes a total abstainer in early life, consumption may be prevented, and long life secured.

Wilcox.—I have no reason to believe that the moderate use of spirituous liquors would have the effect to cause, or prevent, consumption.

Harris.—Yes; as concomitant of good hygienic care.

Brownell.—A temperate use of stimulants is beneficial in this disease.

Butler.—The less a consumptive uses of stimulants the better he will be; and judicious diet, exercise, &c., the less liable he will be to the disease.

Richmond.—In the moderate use of stimulants there is less liability to the disease. (I have been a total-abstinence man for forty-three years.)

Rice.—I have never seen so much consumption among that class of people who use liquors moderately, as among the strictly abstemious.

Eighth Question.

Is Consumption ever caused or promoted by the total abstinence of an individual from Intoxicating Liquors?

Tabular form of returns is as follows:—

	Yes.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, ...	17	71	17	38	143
Outside of Massachusetts, . . .	9	35	3	20	67
	26	106	20	58	210

The preponderance, one hundred and six (50.47 per cent.) of negative over the affirmative, twenty-six (12.38 per cent.) answers, is not unexpected. The cases in which total abstinence would have any marked influence in causing or promoting consumption, if such be ever the fact, must necessarily be very rare. They would indicate either an inability to bear alcohol, or a martyr-like spirit of abstinence for principle's sake; either of which, to the extent indicated, must be very rare in our community. For even the most rigid of temperance advocates do not refuse stimulants when directed by the physician. The small number of affirmative answers, twenty-six (12.38 per cent.), suggests either a careless mode of answering (which I am not willing to admit, inasmuch as each person could, if he had chosen, have declined to answer that question, as in fact, fifty-eight (27.62 per cent. actually did); or it suggests that there are a certain number of cases

in which physicians believe that total abstinence really promoted what the *temperate* use of alcohol might have retarded or prevented.

I am quite sure that there are individuals now in this community, who are ill from various other complaints, in consequence of their strict adherence to rules of total abstinence, and who are immediately benefited by a physician's prescription of the temperate use of some alcoholic medicine. One can believe, therefore, that rigid abstinence might so lower vitality in some persons, that consumption might more easily occur than in others who use alcohol carefully.

Extracts from letters of Correspondents' on this question.

Barber.—In confirmed habits of intemperance, a little stimulant will sometimes prolong life.

Tracy.—The temporary use of alcoholic stimulants is sometimes essential to the prevention of consumption.

Rice.—I believe strict abstinence to be a means of hastening the fatal termination. This has been according to my observation.

Wakefield.—Total abstinence would not cause consumption.

Ninth Question.

Is Consumption ever caused by overstudy at School or College?

	Yes.	Yes; indirectly.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, .	92	4	15	8	24	143
From other places, . .	54	3	6	2	2	67
	146	7	21	10	26	210

The few that have declined to answer twenty-six (12.38 per cent.) indicate the interest the profession has in the question, and not only its willingness, but also its belief, in its ability to answer it. Let us look at the returns, therefore,

carefully, and see if they indicate anything worthy of notice by our legislators and boards of education. A large proportion (including "Yes," and "Yes, indirectly,"), viz., one hundred and fifty-three (72.85 per cent.), answer affirmatively. In other words, nearly three-quarters of the profession, as represented by our correspondents, declare that by our system of education, we really tend to produce consumption. If this be not worthy of serious thought by our people, I know of no question that can be.

Those who answer in the negative, twenty-one (10 per cent.), and those that are doubtful, ten (4.76 per cent.), are comparatively few. Doubtless what one of our most intelligent correspondents (see letter from D. N. S. Davis, of Chicago) suggests, may be, in certain cases, true; viz., that it is not the great amount of intellectual labor, but the small amount of physical work—the total neglect of it, in fact—together with numerous other bad hygienic conditions, which brings consumption to our scholars. I cannot hold wholly to this opinion. I believe with the majority on this question, and sincerely trust that the opinion of the profession thus expressed, will have its due weight. I have seen not a few patients—scholars—who, under the violent stimulus put upon them by an approaching exhibition or examination for rank or for prizes, have sunk immediately after such extra intellectual labor, wholly prostrated in body and mind, and when I have seen them, far-advanced consumption was plain. Such cases are utterly hopeless.

Extracts from Correspondents' letters on this question.

Fiske.—Overstudy and want of exercise ought to promote consumption.

Ring.—I cannot say about its causing consumption; health is often impaired.

Field.—I have not much faith in hard study's causing disease of any kind amongst students. If their health declines, the cause can usually be traced to other sources than study,—as dissipation, bad food, bad air, want of proper exercise, use of tobacco, etc.

Stone.—Overstudy at school or college, or any depressing cause, may develop the disease, if sufficiently continued, in a subject predisposed.

Wakefield.—Overstudy at school or college would not cause consumption unless scrofula existed.

Hammond.—Overstudy is a fruitful source of consumption by debilitating the system.

Hunt.—Confinement and overstudy in academies and schools.

Harris.—Yes ; as sequel to impaired nutrition, &c.

Knight.—Yes ; if insufficient muscular exercise.

Call.—I think I have never seen a case of consumption caused by overstudy at school. They may have received the fatal blow while at school, but from their habits of life rather than from hard study.

Hopkins.—A *mediate,* not independent cause.

Fisher.—Only in connection with some violation of physical laws, late hours, close apartments, vitiated air, excessive mental emotion otherwise than study, and irregularities of various kinds.

Tenth Question.

Is Consumption ever caused or promoted by overwork in trades?

The table stands as follows :—

	Yes.	Yes; indirectly.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, . .	108	4	4	5	22	143
From elsewhere, . .	54	5	4	2	2	67
	162	9	8	7	24	210

As the last question, this, also, becomes very interesting and important when we take a glance at the great number answering in the affirmative, either categorically or with an explanation, one hundred and seventy-one (80.14 per cent.), and compare this proportion with those answering in the negative, eight (3.8 per cent.), or doubtfully, seven (3.33 per cent.), while there are but few that leave the question unanswered, twenty-four (11.42 per cent.). It would seem hardly possible there should be no foundation in the opinion that certain

trades seem to cause consumption. There were only four (1.9 per cent.) out of the whole number who answered simply in the negative. But for the further elucidation of this matter of overwork in trades we may refer to special letters.

Extracts from Correspondents' letters on this question.

King.—I can't say about its causing consumption; health is often injured.

Miner.—Steam work in manufacturing establishments not properly ventilated, or very low.

Haskell.—Perhaps consumption occurs more in those of sedentary pursuits.

Field.—Neither do I consider that overwork, *as such*, causes much disease, but combined with unhealthy food, impure air of shops and dwellings, and among mothers of families with confinement within doors, together with the cares and anxieties attending household affairs and the rearing of children, overwork is productive of many cases of consumption.

Wakefield.—Overwork in trades might cause consumption, especially in an improperly ventilated room.

Hammond.—Overwork, by debilitating the system, tends to cause the disease.

Jordan.—No doubt the excessive efforts of young men and women to get an honest living, confined in small, unventilated workshops, has a great tendency to cause consumption.

Ballou.—Yes, from dust.

Plimpton.—Close confinement and dust will develop an hereditary taint.

Eleventh Question.

Is Consumption ever caused by certain trades?

The table runs thus:—

	Yes.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, ...	102	7	7	27	143
From elsewhere, ...	56	2	2	7	67
	158	9	9	34	210

In answering this question, also, the affirmative seems to predominate very much. For example, we have one hundred and fifty-eight correspondents (75.24 per cent.) out of the two hundred and ten who believe that certain trades cause consumption, while nine (4.28 per cent.) say "nay"; and those who are doubtful are the same in number, while the number of those who do not reply is thirty-four (16.19 per cent.). The answer, of course, only gives the fact that, of the profession, 75.24 per cent. of our correspondents believe that certain trades cause or promote consumption. For the special trades which, in the opinions of the same correspondents, produce the effect, we refer to letters.

Extracts from Correspondents' letters on this question.

Workman.—In Iron-workers.

Greene.—Shoemaking and factory-life.

Brown.—Shoemakers who work in overheated and ill-ventilated shops are especially liable to consumption. The dust-laden air of cabinet-makers' shops seems to excite the disease in those predisposed. Workmen here consider dust of black walnut particularly irritating.

Dickson.—Wood-turning, dry-grinding in scythe-shops, etc.

Belden.—Such as cause the workmen to inhale irritating substances.

Hathaway.—Workers in tin, etc.

Smith.—Close confinement in mills, ill-located and ill-ventilated boarding-houses, poor food, and cotton-dust.

Spofford.—Several have left trades that others do well in. A shoemaker died suddenly at seventy-six, another is living at eighty-five—close workers —on the bench forty and fifty-five years.

Calkins.—Especially stone-cutters and grinders of metals.

Smith.—Where they are confined to dusty rooms.

Burr.—Operatives in cotton-mills especially liable to it.

Stone—Manufacturing shoes, sail-making, etc.

Hills.—Working in palm-leaf.

Dwight.—Polishing-rooms.

Breed.—All those trades which compel to a constrained position, preventing free expansion of the chest, and also those where, from the character of the material wrought, the air is filled with particles of organic or mineral materials.

Rice.—I have known consumption either engendered, or early developed, in grinders and polishers of iron and steel. A polisher, in this section, hardly ever lives more than four years, and almost invariably he dies of consumption. Cannot there be some invention for delivering the polishers from the *emery wheel*, so that only a section of the wheel shall be in the room where he stands, leaving all the works and flying particles of steel in another room; or some protector to wear on the face?

Shaw.—I have no doubt that some parts of pianoforte making and cabinet-making prove *exciting causes*, by the large amount of fine dust necessarily inhaled while veneering and sand-papering the dry surfaces before polishing.

Wilcox.—Have seen it developed in millstone cutters and grinders of iron and steel, but consider it only secondary to inflammation and ulceration of the bronchi.

Goodenough.—Shoemakers.

Priest.—Cabinet dust is injurious; sewing-machines.

Holbrook.—I occasionally see here what is called, in popular language, "grinders' consumption." The main employment of the inhabitants of this village is that of making axes, hatchets, etc. A part of this work is done over the grindstones and polishing-wheels. The air of the rooms constantly contains the insoluble particles of stone and emery. These particles, in the process of respiration, settle in the lower bronchial tubes, and gradually fill the smaller ones completely, until the lungs assume almost the appearance of the liver, and are almost impervious to air. This condition causes a loss of strength and an inability for much exertion, from shortness of breath, which usually ends in the death of the victim in eight to ten years in the case of *grinders*, and in twelve to sixteen years in the case of *polishers.* Death often comes sooner from pneumonia and bronchitis, to which this sort of lung is peculiarly susceptible. Medicines are of but little use in grinders' consumption. Many of the persons having this diease returu to Canada—whence all the grinders and polishers come—as soon as they begin to find themselves unable to perform their accustomed amount of labor; therefore the fatal cases seen here are much less in number than if the operatives were native-born.

Gavin.—Hard work, constant and long hours, with insufficient food, account for many cases of phthisis amongst poor girls who earn their living by sewing. In most of these cases the distance between their residences and workshops is too far to permit of going home for a hot dinner, so that we find them compelled to make, what ought to be the principal meal of the day, on pies and cold meats. I know of no greater evil than this, and some attempt should be made either to give two hours for dinner, or to establish

boarding-houses on the coöperative principle, where good dinners should be furnished at a moderate profit.

Gilbert.—Brass-workmen and shoe-cutters.

Holmes.—Tailoring and shoemaking.

Harlow.—I would mention "machinists," and what are known in tanneries as "beam-house workers," or "fleshers."

Wakefield.—I had a patient who worked in a brass foundry. He complained of the fine particles irritating the membrane of the bronchial tubes. He died of fully-developed tuberculous disease.

Ballou.—From irritation.

Bolan.—Yes, cotton-factory.

Call.—Yes; railroad conductor.

Palmer.—Confining; dusty.

Peaslee.—Sedentary, as shoemaking.

Brownell.—Those are worst where operatives inhale deleterious particles.

McKenzie.—Very common amongst tailors at the West End of London.

Twitchell.—Machinists, particularly those who are engaged in turning iron-castings, or use the emery wheel, I think are more liable to the disease than those who work in wood; unless, as in the rail-shops, they use sand-paper.

McKean.—Watchmakers and jewellers.

TWELFTH QUESTION.

IS CONSUMPTION EVER CAUSED, OR PROMOTED, BY OVERWORK OF ANY KIND?

Here is the tabular statement:—

	Yes.	Yes; perhaps.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, . .	94	3	10	5	31	143
elsewhere, . . .	49	6	3	2	7	67
	143	9	13	7	38	210

The fact shown in the above table indicates that the profession inclines to the affirmative more distinctly than one would have anticipated. One hundred and fifty-two (72.38 per cent.) believe the proposition; thirteen (or 6.19 per cent.) say "nay;" seven (or 3.33 per cent.) being doubtful; while thirty-eight (or 18.09 per cent.) do not answer the question.

It would seem, therefore, that the same thought has occurred to the vast majority of the profession, that has often occurred to myself, during my professional life, viz.: that the people of this country are overworking generally. We have no pastimes; no "long vacations;" we give no rest to ourselves, or our employés. The struggles for life are so great, and the "accursed love of gold," the nature of our political institutions, our stimulating climate, all urge us to work, and to overwork. Even in our parties, during the winter, and at gay watering-places during the summer, there is no rest, but "the dance of death" goes gayly round all the time,—whether we work or play. This is a sad statement, but, I believe, true.

Extracts from our Correspondents' letters relative to this question.

Hitchcock.—Yes; army-life.

Greene.—Dr. Bowditch will, perhaps, recall the case of M——— T———, whom he saw with me, and who died last year of acute tuberculosis. She was the oldest of seven children, then living. Here was no family history of consumption; parents both grandmothers, and several aunts, still living. Her place of residence was elevated and salubrious, not damp. We could assign no exciting cause, unless perhaps carelessness, and application as an amanuensis. Now her third brother, a rather undersized and effeminate-shaped youth, a dry-goods salesman, gives unequivocal signs of developing phthisis, but of a type less acute than his sister's.

Bullard.—No; if out of doors.

Murchison.—Yes, mental overwork included.

THIRTEENTH QUESTION.

IS CONSUMPTION EVER CAUSED, OR PROMOTED, BY SEVERE BODILY INJURIES?

The table is as follows :—

	Yes.	Yes; perhaps.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, . .	61	5	28	9	40	143
elsewhere, . .	41	1	10	1	14	67
	102	6	38	10	54	210

If we can trust the above table as giving the views of the profession generally, as it does those of our correspondents, we must infer that severe bodily injuries do not very generally cause, or promote consumption.

The analysis of the above table shows that 102+6=108 (51.42 per cent.), of the affirmative (and some of these are doubtful) are about balanced by those holding the negative, thirty-eight (18.09 per cent.), the doubtful, ten (4.76 per cent.), and those who do not answer, fifty-four (25.71 per cent.). Here, again, I agree with the small majority. I cannot now remember any case in which I could trace consumption to a physical injury.

Extracts from letters from Correspondents on this question.

Smith.—I think I have seen it follow severe drainage from wounds.

———.—By causing confinement indoors.

Miner.—Saw one case in which it was apparently caused by the debility consequent on a severe wound.

Wakefield.—An injury to the lungs, otherwise sound, might develop the disease.

Haynes.—Yes, if confined to the thorax.

Brownell.—All kinds of chest wounds, and any exhausting disease, or injury.

Fourteenth Question.

Is Consumption ever caused, or promoted, by mental trouble?

The table resulting from our correspondence, is as follows :—

	Yes.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, ...	97	14	8	24	143
elsewhere, ...	53	4	2	8	67
	150	18	10	32	210

The importance of this question cannot be over-rated; and the above table presents very interesting results. If we compare the number holding the affirmative, with those holding the negative, of the question, the difference is very great, one hundred and fifty (71.42 per cent.) against eighteen (8.05 per cent.). Then, too, the number who are doubtful, is small, ten, (4.76 per cent.), and of these who do not answer, also small, compared with what is noticeable about other questions, viz., thirty-two (15.23 per cent.).

Altogether, the returns indicate that the question is an interesting one to our correspondents, and a large proportion of them believe themselves justified in the proposition that mental anguish promotes, or causes consumption. Though at one time expressing perhaps a rather different opinion,* I now must hold to the dogma that we cannot separate the various elements of man. Man is body and mind; they are mysteriously joined, they mutually re-act, one on the other;—psychology, physiology and pathology are irrevocably joined. A healthy mind cannot be in an unsound body; and, vice versa, an unhealthy mind, which mental trouble, even of the briefest duration, must cause, will tend to interfere with some of the fundamental laws of physical health; and by doing so

* Consumption in America. "Atlantic Monthly," February, 1869.

may tend to produce consumption, by a lowering of the vital powers.

Extracts from our Correspondents' letters relative to this question.

Luce.—One case where no hereditary predispositions—young lady—love affair.

Hills.—I can give no special case, but have thought that patients who were given to despondency, waste more rapidly than those who seemed hopeful.

Wakefield.—I think not. Such cases die off by exhaustion of nerve-force, softening of the brain, and effusion within the cavity of the brain.

Hammond.—I think mental trouble tends to cause it.

Fifteenth Question.

Is Consumption ever caused, or promoted, by marriage?

The table is as follows :—

	Yes.	Yes; perhaps.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, . .	47	1	46	9	40	143
elsewhere, . . .	33	2	17	3	12	67
	80	3	63	12	52	210

Our correspondents do not have any decided opinion on the question; eighty (39.52 per cent.) being in the affirmative, and sixty-three (30 per cent.) in the negative, while fifty-two (25.66 per cent.) decline answering. Undoubtedly, a properly governed marriage, entered into by young, reasonable, healthy people, tends to longer happiness and more healthful life than any ascetic celibacy can bring about. But the exceptions to this state of perfectly robust health, on the part of contracting parties, are numerous, and I have little doubt that in some instances, consumption

may be promoted, if not caused, by marriage, if imprudently contracted, and subsequently unwisely or incautiously consummated.

Extracts from letters from Correspondents on this question.

Ward.—I don't think matrimony necessarily has any effect, either as cause or cure, or even in preventing or accelerating the development of tubercular disease. If improperly or excessively employed,—as in child-bearing or sexual indulgence,—it undoubtedly often does.

Hunt.—Early marriage is a cause.

Haskell.—By overbearing of children; and confinement.

Reynolds.—Yes; in the female.

Stone.—Yes; if unhappy.

Smith.—I believe excessive venery induces the disease.

Nichols.—I have known many cases in both sexes where individuals having no hereditary predispositions to this disease, and marrying those who were so predisposed, have had the disease developed, and which has gone on to a fatal termination.

Field.—Marriage, in itself, promotes health. And yet many a woman entering the marriage state with a physical system enfeebled by unhealthy modes of living, training and education, and perhaps constitutionally disposed to disease, finds an early grave from phthisis, promoted by the bearing, rearing and care of children, together with other injurious influences.

Mann.—Yes; when the partner is tuberculous.

Haskell.—By early marriages and frequent pregnancies.

Belden.—Rather increased after birth of child.

Abbot.—When physically and morally coaptated.

Spalding.—Yes; promoted in persons predisposed.

Knight.—No; unless over-indulgence in the sexual relation.

Hopkins.—Promoted not by marriage but by the burden of domestic cares.

Sanborn.—Marriage is not necessarily a cause of consumption, but inordinate sexual indulgence which almost invariably follows, is, in my opinion, one of the chief causes of consumption.

Carbee.—Not, except where the parents are predisposed.

Bullard.—Two instances where but slight signs of any taint, but the inordinate sexual intercourse produced the disease in the female.

Brownell.—Not in itself, but from sleeping with and inhaling the breath of a consumptive person.

Eldredge.—If marriage did not bring an increase of cares it would have a favorable influence in both sexes, but as it generally does, it oftener has the contrary effect.

Mackenzie.—With men, but not with women.

Snow.—I have no doubt, from personal observation, that early marriage and the early development of the sexual function tend to promote consumption.

Smith.—Marriage commonly promotes health, and hence may check consumption, but when it brings undue burden or indulgence, especially too frequent child-bearing, it promotes its progress.

Howe.—I said *promoted* simply because I find marriage is almost always attended with inordinate sexual indulgence, especially in the young. Were it not for this fact I do not think it would be considered a promoter of consumption.

Hurlbert.—I think consumption, in this locality, is promoted more by intermarriage than by any other cause except hereditary taint.

Sixteenth Question.

Is Consumption ever checked by child-bearing, &c.?

The table is as follows :—

	Yes.	Checked during gestation; more rapid after.	It is possible.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, . .	71	22	4	21	6	19	143
From elsewhere,	32	15	2	12	1	5	67
	103	37	6	33	7	24	210

This table is interesting in several respects, viz., first, suggesting the interest the profession has in the question, only 24 (11.42 per cent.) having declined to answer it. Second, in the fact brought out by 37 (17.61 per cent.) that consump-

tion, while being checked by pregnancy, seems to run on more rapidly after delivery. Third, including the three first columns under the one head of affirmative, we learn that one hundred and forty-six out of the two hundred and ten (69.52 per cent.) of all the correspondents believe that consumption is checked by child-bearing.

Extracts from Correspondents' letters relative to this question.

Deane.—Its effects are modified very much by circumstances; sometimes checked, sometimes promoted.

Shurtleff.—Seems to retard it till confinement, and then to hasten it to a fatal termination.

Blood.—Checked while with child, but rapidly advancing after the birth.

Lindley.—I think I have seen it checked, but too often child-bearing promotes it.

Spofford.—Several died soon after delivery.

Burr.—Have notes of two cases of marked phthisis checked by child-bearing.

Winsor.—I am confident that I have seen the progress of the disease checked while pregnancy lasted, some half a dozen times. On the other hand, I have seen it hastened by lactation.

Blodgett.—Have now under operation a lady who, having borne three children in as many consecutive years, seems to have laid the foundation of a continually progressing tubercular action by this constant requisition upon her surplus vital energies. The family have a tubercular taint attending each generation, this lady only, of the present generation, having been the subject of tubercular activity. The connection between manifest tubercular action and the exhaustion consequent upon too frequent parturition, here seems to be plain and direct.

Stone.—I have just lost a patient from consumption, who was delivered of a seven-months' child on the day of her death. She came under my care about the time she became pregnant, and her disease steadily advanced,—her condition rather made worse by her pregnancy,—till her death. The autopsy showed most extensive disease of both lungs, tubercular in character. Consumption is not a frequent disease in this town, and the population is too changing to permit me to express any opinion decidedly.

Reed.—I have known several cases where the progress of the disease seemed to be checked by repeated pregnancies with short intervals. Prolonged lactation develops the disease rapidly.

Morse.—I have known of five cases where women having consumption, the disease was checked on becoming pregnant; but they died soon after parturition, the disease progressing with renewed vigor. I think I have seen several cases of consumption caused or promoted by lactation.

Luce.—I have known cases checked by child-bearing.

Rice.—Child-bearing often hastens the development of tubercular phthisis.

Haskell.—Those I have seen were cases of *apparently incipient* phthisis, and from the extreme suffering of the *first three months*, attended by a cough, &c., they certainly did better for a time. In other cases, doubtful effect.

Knight.—Checked during pregnancy, but developed rapidly afterward.

Carbee.—The disease is seemingly transmitted from the child to the mother.

Bullard.—No; but promoted.

Condie.—It is a curious circumstance to how great an extent in a female with confirmed consumption upon her becoming pregnant the symptoms of the disease will assume a favorable aspect, foreshadowing, as it were, a speedy convalescence, but rapidly after parturition the disease will assume an unfavorable aspect, running on quickly to a fatal termination. (I would refer you to two papers of mine in the "American Journal of Medical Sciences," April, 1871, page 365; July, 1871, page 119.) I have prepared a paper which may appear in the October (1871) number of the "American Journal," it is on "spurious or simulated consumption."

Eaton.—Many of the causes, &c., in the list of questions might be connected. Thus marriage might promote phthisis, from sexual imprudence in either sex; while in the female during pregnancy it might be, and usually is, *checked*, but after the child is born the tubercular deposit is increased, and also the softening.

Seventeenth Question.

Is Consumption caused or promoted by Inordinate Sexual Indulgence?

This question is one which, from its very nature, must be very difficult to answer. We must depend for its perfect solution upon not only the utmost skill and penetration on the part of a physician, but likewise for perfect certainty, upon the voluntary confession of sufferers, and confession, too, on a point which is rarely alluded to by any one, even to his most intimate friend. In fact, a perfect knowledge on the subject presupposes not only a species of confessional such as, it is true, sometimes exists between physician and patient, but likewise it requires great wisdom on the part of the prac-

titioner, not to be led by the self-accusation of the patient into a belief of the influence of this cause as a chief element in the production of the disease actually existing. Believing as I do, that there are very rare cases in which there can be little or no doubt of the importance of this cause, I hoped to obtain some facts to elucidate the whole matter, and therefore the general question was asked.

The table resulting is as follows, and certainly it seems to prove that the question was not without point in the estimate of our correspondents.

	Yes.	Yes; also onanism, &c.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, .	91	3	12	9	28	143
elsewhere, . .	56	2	4	2	3	67
	147	5	16	11	31	210

One is struck with the small percentage of correspondents who are doubtful,—11 out of 210, or 5.23 per cent.; and also of those who do not vouchsafe a reply; 31 out of 210, or 15.23 per cent. The few who categorically answer "nay" is small, viz., 16 out of 210, or 7.61 per cent. And finally, we may notice the large proportion who believe that this over-indulgence or a vicious habit are promoters of consumption, viz., one hundred and fifty-two out of two hundred and ten (72.38 per cent). I cannot help commending this result to the serious consideration, first, of the wild, thoughtless and licentious; and, second, of all who think that marriage absolves from careful attention to the laws of health in this particular. And here may be laid down one general rule that must be true, viz., first, that when there is no healthful vigor of body and mind, but rather the reverse, after indulgence, extreme prudence should be the guardian of the family relations; and, second, that when extreme lassitude, nervousness or any special *malaise* follows such indulgence, either great abstemiousness or total abstinence for a time should be inculcated, until by proper regimen or treatment the healthy condition of system is regained.

Extracts from Correspondents' letters relative to this question.

Stone.—Overwork or mental trouble, or immoderate sexual indulgence, especially self-abuse, may at times be a cause.

Greene.—Onanism is a cause.

Harlow.—I am well satisfied that inordinate, or even moderate, sexual indulgence has a tendency to develop tuberculosis.

Packard.—Consumption is a mental disease arising from the improper relations and bad conditions of our social marriage system,—the same as all the forms of intemperance. It is the result of an overactive cerebellum excluding the higher faculties of soul, life and will-power. Hence a premature decay of the whole being. It is preëminently a hereditary disease,—self-begetting and self-sustaining.

Hammond.—I think this a cause of the disease. Whatever tends to debilitate the general system exposes the individuals to those diseases to which he is predisposed. There is a vital elasticity in the animal system which causes the system to recover itself from abuses, but the elasticity is greatly impaired by too frequent use. There are many of those causes mentioned in your circular that seem to act no part in the production of consumption, but, to those hereditarily disposed, would act a very important part. Hereditary predisposition to any disease does not necessarily doom the individual to death from the disease to which he is predisposed. For, by avoiding those causes that would tend to develop the complaint to which he was predisposed, he would die of some other disease. That some persons are hereditarily disposed to consumption there is no question in my mind. Although there may be no particular indication in early youth, yet, when the system becomes developed, and the functions of the organs of generation come into operation, then a drain is produced upon the system that brings with action the latent disease.

Sanborn.—Married people should be advised to occupy separate sleeping-apartments, except, perhaps, semi-annually. And children should be kept so busy at work or play, that they would be tired enough to sleep soundly through the night. They should be furnished with suitable employment, a portion of the time, with pleasant reading, music, light games, &c., so as to leave no time to learn, or learn of, pernicious habits and customs until they arrive at maturity, and then taught to avoid them as they would a tiger. Tobacco is another cause of consumption; worse, if anything, than rum.

Manson.—Yes; also by onanism.

Bullard.—According to my observation there is almost always a hereditary influence; but that solitary pollution and inordinate sexual indulgence have as much, if not more, to do with its development than any, or perhaps *all*, other causes.

Eighteenth Question.

Is Consumption ever caused or promoted by contagion or infection?

Under the light of modern investigations as to the inoculability of tuberculosis, the question of communication of the disease from one person to another, becomes a vital question. Dr. Budd, of Bristol, holds that the dried sputa have particles in them of the real "*contagium*" of this disease, and that they must be floating about in every atmosphere in which a consumptive is living. He lays great stress on this matter of communication of the disease in that numerous class of cases, usually attributed to a hereditary tendency, and where the disease runs through many members of a family.

Deeming the question thus important, the views of our correspondents become deeply interesting. Their answers, let it be always remembered, are grounded on their own everyday experience, and not on books.

The table runs thus, and we are at a glance struck with the difference between the views of correspondents on this and on the preceding question. These views are less decided. There are less in favor of, and more against the proposition, while the number of skeptical has increased.

	Yes.	Yes; occasionally, when under really favorable circumstances.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, .	70	4	31	18	20	143
elsewhere, . .	30	6	14	9	8	67
	100	10	45	27	28	210

One hundred and ten out of two hundred and ten, or 52.38 per cent., answer affirmatively; while forty-five (21.42 per cent.) answer "Nay." Twenty-seven (12.85 per cent.) are doubtful; twenty-eight (13.33 per cent.) make no reply.

Evidently those who believe in the contagion or infection are not so numerous or so sanguine as they are upon some other questions submitted to them. May not the fact of the hitherto

great prevalence of the opinion of the non-contagiousness of this disease among English and American practitioners, and our strong belief in the hereditary character of it, have led us all to ignore what may, after all, prove a potent cause, and which we shall recognize on more close inspection? The question is of much importance. Physicians should be prepared to give directions as to the use of the same bed or chamber by consumptives and members of their families, or by their friends. I must defer a more elaborate statement on my own part, to a subsequent paper; but I will say that I have, for years, always endeavored to prevent any one from sleeping with a consumptive. If possible, I prefer the patient should be in one room, the attendant in another; with the door open between them, perhaps; but I never allow any one to sleep in the same bed with the consumptive. I direct that the attendant should not only thoroughly ventilate the room or sleeping-chamber, but that, each day, the attendant should walk or drive out a sufficient length of time to enable him or her to get pure air in abundance.

Extracts from letters from Correspondents relative to this question.

Chase.—From inhaling the breath of another, &c.

Hathaway.—Yes; after measles, typhoid diseases, &c.

Wilcox.—Healthy husband or wife by continued exposure from the other.

Nichols.—I think a child, free from all hereditary taint, might contract the disease by sleeping with a person having consumption.

Chapin.—I think in two families hereditarily disposed that it was produced by contagion, in some of the members of each family and their kindred.

Brown.—I have sometimes thought it contagious or infectious, particularly in members of the same family living together, and exposed to the same influences.

Gott.—A husband, not predisposed by hereditary taint, died of the disease apparently caused by taking care of his wife during her sickness. The wife also apparently contracted the disease while taking care of a brother. I have seen several similar instances appearing to originate from contagion.

Breed.—I have seen cases where the disease seemed to be developed by close contact, as in cases of husband and wife, or sisters habitually using the same bed, while in one of them the disease was fully developed.

Brown.—I am more inclined than I was at one time to attach importance to the influence of contagion. In two cases which have come under my notice the disease seems to have been communicated from husband to wife, resulting fatally in a short period in both cases.

Ward.—Perhaps persons much with consumptives,—rooming and sleeping with them,—are much more likely to contract the disease. I think such cases have several times come under my observation.

Smith.—I have now under my care a lady,—widow,—whose husband died of consumption. No hereditary influence predisposed to phthisis, but from *intense grief* lowering vitality, or from *materies morbi* derived from husband, or, as is probable, both causes acting together, she contracted phthisis. She has hemorrhage and tuberculated lungs, and probably will die before many months. Before the death of her husband, three years since, she suffered severely from whooping-cough. First hemorrhage about a year since.

Calkins.—In very many cases, I have the opinion from my own observations, that consumption is communicable by contagion or infection. The cases of persons attacked after exposure have been those who have been confined with the sick, in small, ill-ventilated rooms, or where the persons exposed *have slept with the sick for some time.* In several instances, persons who have no hereditary tendency to tuberculosis, have been suddenly attacked with all the phenomena of phthisis after full and continued exposure. My observation has continued for a period of twenty years, most of this time in Hampden County, Mass.

Blanchard.—An interesting case occurred here some years since, in which consumption seemed to be promoted by contagion. The case was that of a young wife who never had a child. During the sickness of the husband with consumption, the wife was constant and assiduous in her attentions, remaining much of the time in the sick-room, and notwithstanding the remonstrances of friends, sleeping there at night, and (during at least a portion of the time) in the same bed with the invalid. There was an inherited predisposition to consumption, her mother having died of that disease, but there was no special manifestation of it, in her case, until after this continued contact. After the death of her husband it rapidly developed, and she succumbed to its ravages. Making due allowance for the effects of anxiety and grief, it always appeared to me that contact and infectious air had a large share in the development of the disease.

Rice.—I am a firm believer that consumption is a contagious disease, much more so than is generally believed. I have in my mind several cases where there was almost positive evidence of contagion. Mrs. J. C. M———, a lady about sixty, died last spring, after having the disease two years. Her husband, before she was taken sick, was a perfectly healthy man, with sound lungs. He took care of her, slept with her, and nursed her. Soon after her death he began to cough, and went rapidly down with consumption. There have been no cases of the kind in his family for two generations. I believe he took the disease by infection.

Bullard.—I know of two instances of the wife's taking the disease by sleeping with her husband, and when the wife had no hereditary taint.

———.—I believe that consumption is caused or promoted by contagion, or infection; so perhaps a better word would be *ingrafting of pulmonary tubercle*, and it is to avoid this that I would have a child, already predisposed to the disease, removed entirely from its influences. I think that many physicians, if not most, know cases in their practice where the nurse of a consumptive patient has died of tuberculosis within a short time. Case: Miss ———, aged 34, a strong, healthy, fleshy woman, weighing upwards of 140 pounds, no consumption in the family, nursed Mrs. B——— during a long sickness,—tuberculosis,—which continued nearly two years from first attack. It was noticed that she had a slight hacking cough during the last of her attendance, but no particular notice of it was taken at that time. Evident signs of tuberculosis were found shortly after the death of Mrs. B., and within eighteen months she died of well-marked consumption. I have seen other cases, but none as well marked as this.

Knight.—Yes; under very favorable circumstances.

Carbee.—Yes; by constantly inhaling fetid breath.

Hopkins.—I have left the question unanswered. If consumption does occasionally follow close upon whooping-cough, or measles, it is probably an open question whether the impression left by the specific contagion were, itself, the predisposing cause of phthisis, or only the exciting cause of a predisposition before implanted. I have thus offered what is suggestive, not statistical.

Carr.—Yes; as a sequel to contagious disease. It sometimes follows virulent clap, and where there is hereditary taint, frequent miscarriage induces the disease. Everything which has lowered the vital forces below a certain degree, whether our habits, location, sickness, exposure to sudden atmospheric changes, or any other debilitating influence, promotes the development of consumption in a person springing from consumptive parents.

Butler.—There are well-authenticated cases on record (see Amer. Jour. Med. Sciences, 1871) which seem to favor strongly the idea of its contagious nature, but my opinion is not fully settled, though I am inclined to the belief that, under certain favorable circumstances, it may be communicated from one person to another.

Heath.—A family which I have occasionally attended as physician has had, within the past two years, four children between the ages of eighteen and thirty-two return home to die of consumption,—one from Ohio, two from New Jersey, and one from Connecticut. The mother is healthy; the father, now at the age of seventy, is able to labor on a farm, but has been troubled with a bad cough for many years. The most intimate relations and favorable conditions for contagion or infection exist between husband and wife, but I have never known a case to be so communicated.

Gavin.—I am thoroughly convinced that phthisis is frequently caused by contagion, and deserves to be classed with typhoid fever in this respect. I have seen unmistakable evidence where a healthy wife contracted the disease—phthisis—from sleeping with her husband suffering from that disease, and vice versa. So much am I convinced of the truth of this statement that

I always forbid a healthy man from sleeping in the same room with a phthisical patient.

Wilmarth.—I can mention one marked case. A lady, mother of three girls, belonging to a family apparently free from consumption, became consumptive when the oldest girl was eight or ten years old. She lived about ten years in a consumptive condition. During the last three years of the disease her oldest daughter was her constant attendant and nurse. The breath of the patient was offensive, and she raised large quantities of thick sputa, which had the same offensive smell as the breath. About a year after the mother's death the oldest daughter went into consumption, and presented the same symptoms that her mother did, except that in her case the disease ran its course in a few months. Her death occurred about four years ago. The younger sisters, who were not so much with their mother as the older one, are now living, and apparently well.

Jordan.—We very often see one healthy individual who, in the habit of sleeping with a consumptive, follows with the same disease.

Nineteenth Question.

Is Consumption ever caused or promoted by an exposed location of residence?

The table gives the following results :—

	Yes.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, . . .	85	24	7	27	143
elsewhere, ...	44	14	–	9	67
	129	38	7	36	210

One hundred and twenty-nine of the two hundred and ten (or 61.42 per cent.) think the exposure of a residence may have some effect in this disease, and thirty-eight (18.09 per cent.) deny the fact. Seven (or 3.33 per cent.) are doubtful, and thirty-six (or 17.14 per cent.) do not answer.

One cannot say that the cause seems to be a prominent one, in the eyes of the majority of our correspondents.

I used the expression "exposed" in order to find, if possible, if the simple exposure to violent atmospheric changes, from the situation of the homestead, tends to promote consumption. The question is in contradistinction to the next

question, which has reference to the effect of moisture, and upon which we have no doubt, from investigations made in America and England. I think that my experience justifies me in saying that *simple exposure* rarely, if ever, causes consumption. But, when combined with moisture of soil in and around houses, it is a prominent fact in the annals of consumption in any community.

Extracts from letters from Correspondents relative to this question.

Ward.—Dwellings should be exposed to wind and sun.

Burr.—Consumption occurs as frequently among families who live on the ridge highland as in the other portions of the city.

Spofford.—If the ground is dry its situation near the water does not affect health. For fifty-three years I have lived near the Merrimac River; am eighty-three years old,—wife is eighty-one. Can mention seven near neighbors above eighty years. To these may be added, of three hundred deaths (in the course of the last few years) six, from eighty to eighty-seven; one, ninety-five, and another ninety-seven. In the present population, 1,600, there are now five aged ninety, and twelve between eighty and eighty-five.

Jordan.—Excessive exposure to heat and cold exert a great influence in producing the disease.

Aiken.—If to malaria, etc., yes; if to sun, etc., no.

Carbee.—Yes; by exposure to pernicious winds.

Eaton.—An exposed dwelling may promote it, especially if exposed to *damp* winds, when a *dry* exposed place might for a time, retard it. Thus is seen the difference between the climate of Minnesota and Iowa. *There* the weather seems as cold, and it is as windy as *here*, yet the atmosphere is dry there, instead of being moist as in New England. *There*, a new case of Phthisis Pulmonalis is rarely developed, yet many die who go from *here* with the disease far advanced. *There*, many times in cold weather, the air feels icy and frozen, as if coming from very cold water. Such air, of course, must be bad for the consumptive—such has certainly been my experience in practice.

Twentieth Question.

Is Consumption ever caused or promoted by a wet location?

	Yes.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, ...	110	17	1	14	142
elsewhere, ...	58	4	1	5	68
	168	21	2	19	210

Upon this question the profession is more nearly unanimous, than upon most of those that preceded it. This is probably owing to the fact that investigations carried on in Massachusetts, many years since, by myself,* and subsequently, in England, by Dr. Buchanan, under the special directions of the Medical Officer of the Privy Council,† have fully proved that residence on a damp soil tends to the production and promotion of consumption, in New and Old England.

These investigations and these results have probably given an explanation to the prevalence of consumptive cases in the practice of physicians, which previously were less explicable.

The percentages are as follows: one hundred and sixty-nine (80 per cent.) take the affirmative; twenty-one (10 per cent.) the negative; two (0.95 per cent.) are doubtful, and nineteen (9.04 per cent.) have returned no answer.

Extracts from letters from Correspondents relative to this question.

Ward.—Dwellings should not be exposed to cold or dampness.

Brown.—I am more and more impressed with the influence of location, as

* Annual Discourse before the Massachusetts Medical Society, by Henry I. Bowditch, M.D., also Prefatory and Historical Remarks by the same author to "Consumption in New England and elsewhere, or soil-moisture one of its chief causes." 1868, David Clapp.

† 9th and 10th Reports of the Medical Officer of the Privy Council. 1866–7. London.

determined by low levels and damp surroundings. I think that the use of cellar-kitchens in certain localities, is decidedly unhealthy.

Barker.—In exposed, wet, damp and foggy locations, the general health and strength suffer, and consumption is promoted.

Downes.—I have a patient, at present, who has two homes,—the one on a dry, sandy soil, the other near a large brook and pond. While at the latter, she coughs more, and invariably feels worse.

Torrey.—I have often seen consumption apparently checked by change of locality, by going to Southern or Western States where the atmosphere is dry. I think consumption is very much on the increase here (Braintree), owing to the moisture of the land. I think, also, it is owing to the occupation of a large portion of the inhabitants, being manufacturers of boots, and working in small, close shops.

Brigham.—Have attended two cases of consumption following colds contracted by moving into new houses before the plastering had become thoroughly dry.

Adams.—I came to Stockbridge thirty-three years ago. At that time and during the ten years following, there were in the village, several cases of consumption,—all young ladies from sixteen to twenty-five years of age. I heard then no opinions of the cause, except the habit, said to have been prevalent, of evening walks with slight protection. It seems to me that the evenings then were much more damp than they are now. For nearly twenty years I do not remember a case of consumption originating here. The plain is sandy, and the soil in the meadows on the banks of the Housatonic is so porous that the water filters through it and quickly reaches the river. Our village has been supplied, since 1864, with pure water from the mountain. Typhoid fever has been rare during the last five or seven years; previously, the disease was quite regular in its autumnal visitations. Drains and cellars receive proper attention, and care is taken to render them inoffensive.

Morse.—I am convinced that living in a valley near water is an active cause in producing consumption. But this, I believe, is universally conceded.

Metcalf.—Consumption is rather a rare disease (more rare, I think, in the last twenty-five or thirty years), in the circle of my practice; and oftener occurring in families located in exposed situations, and *especially if the site is wet.*

I would invite especial attention to the following letter:—

Huse.—The marked prevalence of phthisis in Georgetown, is undoubtedly due to the extremely moist condition of a considerable portion of the soil. The town being located at the intersection of two main roads which traverse a large area of fresh meadow-land, a large basin collecting the drainage of a large area of upland. The immediate centre of the town is of gravelly soil, quite pervious to water, and is quickly dry; but the south-east, south and south-west

portions are boggy and wet, inundated by freshets, and filling many cellars with dampness, if not with water. The meadows, like all others at certain temperatures, give many noisome and thick fogs, which completely envelope these portions of the town, only to be dispelled by the next day's sun, or a favorable wind. At these times, any one standing on the neighboring hill, can see only the tops of the most elevated buildings, which appear to come out of an immense cloud. The town is but little shaded, though considerable woodland is in the outskirts; but in the inhabited portion, the sunlight has free ingress. As in all basins, there are several ponds, of several hundred acres area in the aggregate, which, with the flowage of the meadow-land, serve as a mill-privilege, thereby increasing the sources of dampness, besides being the cause of much litigation because of damages incurred by overflow of gardens.

Chamberlain.—The causes of consumption are sometimes past finding out, as the following circumstances will show: Two brothers living in this town, when young men, built themselves houses, not more than fifty or sixty rods apart; one built a wooden house, on a slightly elevated, sandy locality—the house is not shaded at all, but takes the sunshine freely throughout the day. In this he reared a family of twelve children, eleven of which are now living, the youngest being about thirty years of age; a part of the family still occupy the house, and no case of consumption has ever occurred in the family. The other brother built a brick house on a spot neither elevated nor low; the site is not wet, but is not as dry, and is a little less elevated than the point selected for the wooden house built by the first brother. Here he reared eleven children, and has occupied the house probably forty years. The house is considerably shaded on the south front. Within the last twenty years there have occurred, in this family, nine cases of consumption. Both of these houses front to the south, and both are equally exposed to the north-west winds. Consumption is not hereditary in either family, through father or mother. I know another family in which consumption is not hereditary, who occupy a house in which sunshine can scarcely enter, in consequence of shade-trees and the peculiar build of the house, which has lost six children by consumption. They all arrived at adult age, however, before disclosing symptoms of the disease. In regard to the mortality attaching to the brick house above mentioned, the shading of the south side cannot be considered a cause, as the disease first showed itself before the trees were large enough to shade the premises. I can call to mind several similar instances. My own conviction has been for many years, that consumption loves a moist locality and a dark dwelling. I have noticed that houses built upon a dry subsoil, and so constructed that they admit the sun freely, are generally free from consumption. A dry locality, with plenty of sunshine, warm clothing, and good living, will never breed consumption; with these blessings surrounding a person he may, even if he inherits a predisposition to consumption, keep the disease at bay, and live to a good old age.

Holmes.—Yes; and east winds and fogs.

Cushman.—It has been said in official reports, that in this town—Randolph—consumption is more prevalent than in any other town in the State. It will be difficult to account for the fact; Randolph is high and dry land. The land between us and the ocean is lower than it is in Randolph. The

east and north-east winds come to us loaded with decayed vegetable matter from the lowlands of Braintree and Quincy.

Wheeler.—I am quite positive, from well-marked observation, that dwellings situated on northern declivities, with low, damp lands below,—for example, a marsh or a meadow, either fresh or salt, to the eastward,—are peculiarly exposed to consumptive causes. I have seen whole families, so exposed, fade away in a few years, after having reached adult life, especially the younger members—the children more frequently than the parents. This I have observed in families where the children have been born and reared in the locality.

Greene.—Our little town has been more than usually afflicted by the dreadful disease to which the circular calls attention. One little hamlet on the banks of the North River, our principal stream, has four new cases. This village is very low, and is almost every night enveloped in a fog. A hundred rods to the north of this village is another case—a young mother with four children. This case is apparently an example of a variety of causes combining to produce the dreadful result—consumption. The causes in this case are (1), hard labor at cotton-weaving; (2), frequent child-bearing; (3), foggy air, muddy soil, and perhaps foul drinking-water—for the patient uses water from a spring which was often white as milk, with clay; and her abode is a factory tenement on the bank of a canal which supplies power to the mill she worked in. The soil is always damp there. I have one patient who contracted the disease while a "commercial traveller" in Michigan, a notoriously swampy State. One patient is the daughter of a woman who was cured of consumption years ago. I have this statement from her (the mother's) attendant, Dr. A. C. Deane, of Greenfield. Her mother recovered under the influence of change of air, exercise, and cod-liver oil. The daughter's disease followed (1), hard work at cotton-spinning; (2), wet location of home; (3,) pneumonia, right lung, which is now the seat of tubercle; (4), drunken habits of father; (5), previous tuberculosis of mother; (6), irregular menses. Two cases are children of a mother who died (as I believe) of leucocythemia; she certainly had anæmia, exophthalmos, and slightly enlarged thyroid gland. Both live in a foggy, wet spot. One case died of consumption, following, and complicated by severe chronic pharyngitis. This case was apparently made worse by child-bearing. A boggy pasture is in the rear of the house.

Mayo.—I believe a cold clayey soil develops consumption, from its exhalation of moisture, causing damp dwellings; with miasma from the soil, etc.

Manson.—I have observed, in two or three instances, where no hereditary taint existed, several children carried off by consumption; and where the homestead was situated on an elevated and dry situation.

Bullard.—A young man, aged twenty-six, with slight, if any, hereditary taint, living in a low, wet place, almost over a mill-pond, was taken with incipient phthisis. He was removed to a dry locality, and is now under treatment, and nearly free from any trace of phthisis.

Haskell.—Exposure, and sea-fog.

King.—I know a family living in a wet situation which I think has helped develop the disease. Without the hereditary predisposition I know of no

case occurring in wet localities, or caused by any particular work, or overwork.

Rice.—Low, damp, foggy situations engender and develop the disease. A person with consumption will die much sooner in such a situation than in a high, dry, airy location.

Wakefield.—A house exposed to damp east winds would promote, or at least aggravate and hasten its development.

Hammond.—Wet locations especially liable to cause it.

Hunt.—Damp, low and shady residences promote it.

Harris.—Inquiries that I had begun upon general sanitary questions in every town in the State of New York in 1859, as a Committee of the State Medical Society, prepared me to believe your opinions (viz., that soil-moisture is a prominent cause of consumption in New England, and probably elsewhere) were well founded, when you first mentioned them to me in 1862.

APPENDIX.

GENERAL ANSWERS NOT REFERABLE TO THE PRECEDING QUESTIONS.

Luce.—I have known one case, a young man, a close student and college graduate, who died of consumption, where there was no hereditary taint, but the parents were cousins.

Wakefield.—To sum up all, I should say that catarrhal symptoms often engender phthisis.

Hunt.—Crowded, ill-ventilated sleeping-apartments, sedentary employments, residences in crowded parts of the city. Warfare against dancing as an amusement for the young, insufficient clothing in cold weather, etc.

Bigelow.—Mr. and Mrs. M. had no tubercular taint, nor had their ancestors. Two of their three children were strong till after puberty, and then died of consumption. I can describe some other families with the same conditions.

Clary.—I have preserved no statistics of cases which have come under my notice, but will state some facts of my family history. My father, a clergyman, died of consumption, at the age of forty-nine: his father, a physician, died of consumption, at the age of sixty-five: an older brother of mine who had been quite vigorous and healthy while leading *an active out-of-door life,* after engaging in business in the city, confined to a store, and soon after, marrying, began to decline and died in about three years, of consumption, at the age of thirty: an older sister, *after teaching for some length of time,* began, at the age of twenty-eight, to decline,—had decided dulness at the upper part of left lung, with hæmoptysis. She left her school; went, in the fall of the year, to the home of a relative; took iron, etc.; lived well; rode out, at all temperatures; grew fat; and returned to New England the next spring, thirteen years ago; and has had, so far, comfortable health, in this respect; not married. Our mother belonged to a healthy and long-lived stock. Four other children (including myself) living active lives, are past middle life, with families.

Palmer.—I believe that "Consumption" is often the result of chronic pneumonia, sometimes of chronic bronchitis, and sometimes of hæmoptysis, &c. According to my observation primary tuberculosis does not occur in so large a proportion of cases as most authors (except the Germans) appear to teach. I have given much attention to this point within a few years past, and am very confident that in this locality (in Michigan) and also in Brunswick, Me., where I have observed and traced the history of cases coming

to clinics, very many originate in inflammation—perhaps it is safe to say, one-half. By "Consumption," I mean wasting disease of the lungs.

Aiken.—Belonging to a consumptive family on my mother's side, she having died of pulmonary consumption at thirty-two,—her parents died of pulmonary consumption under forty,—I have, myself contended with infirm health all my life. I was brought up in Boston from seventh to nineteenth year, under the high-pressure system of the Public Latin School. My father had two sisters, one of whom has had to fight for her life against consumptive tendencies. She has taken two voyages, one to the Holy Land and one to Australia, India, Egypt and England, but is now alive and still fighting, bringing up a family of four children, from seven to thirteen years of age. A country practitioner, now, these dozen years, I know whereof I affirm. The only survivor of my mother's family is sixty-five years of age. I am not aware that he has ever suffered seriously from pulmonary difficulty.

Adams.—The disease is rare in Pittsfield. A few persons die of consumption, but the majority of cases which come under treatment in an early stage are very readily cured. Persons suffering from consumption coming here from lower-lying districts are very apt to receive permanent benefit from the change.

Holbrook.—In a practice of nine years I have had in charge, at death or previously, some fifteen cases of tubercular phthisis. My records show me two cases for 1864, one for 1865, three for 1866, three for 1867, one for 1868, three for 1870, two for 1871. Two of these were in young persons who began to work early in life, and were, until disabled by sickness, still in a cotton-factory. Three elderly females had the disease certainly intensified, if not caused, by the hard, monotonous toil necessary in a large family. One young man brought on his consumption by overwork, both physical and mental, in carrying on a country store, aided by great irregularity in meals and sleep. Another young mother broke down under frequent child-bearing. The balance were apparently caused from hereditary taint. But as my practice embraces a large number of patients annually, during the last six years I have given medicine to from fifty to ninety a week. My opinion is that consumption is *not* a frequent disease in my circuit of practice. My preventive measures are chiefly hygienic, especially insisting on out-of-door employment.

Jordan.—Fashion lays the foundation for more consumption than all other habits combined. The efforts of mothers to produce abortion upon themselves is another cause; but this is a part of fashion.

Hunt.—Indigestion from improper food, too much meat and gross food in summer, too little meat in winter, with new bread, rich cake and pastry, all the year round.

Ballou.—One should endeavor to avoid having consumption arise in his family by marrying a healthy partner. Corsets and thin shoes, or whatever deteriorates the blood or destroys nervous sensibility, are causes of consumption.

Robbins.—Consumption is caused by every means which in any way lowers the vitality of any organ: First, bad air in sleeping-rooms; second, any im-

purity in air of a locality which predisposes to any disease whatever, especially that (whatever it is) which causes typhoid to prevail. I do not agree with Dr. Bowditch's dampness theory; think it is the impurity associated with the dampness, rather than the dampness itself, which predisposes to consumption. I am certain that fogs which prevail on the eastern coasts of Maine and in Nova Scotia do not give rise to it, while I feel equally certain that those occupying dwellings on marshy or ill-ventilated localities, or on the sides of fresh-water streams whose beds are left dry, or partially dry, in summer, opposite the prevailing winds, are peculiarly liable to it. Third, changes in weather causing irritation, congestion and flabby condition of air-passages. Therefore, improper clothing and poorly-warmed houses. Fourth, poor or restricted diet, lowering vitality of blood, or deranging digestive system. Fifth, any cause whatever, predisposing to dyspepsia, e. g., bad cooking, wrong use of tea, coffee, tobacco, stimulants of all kinds, absorption in business, mental unrest, eating when weary, too many meals, too few meals, too hard work after meals, &c. In consumption I think one of two things must precede, either a *low chronic pulmonary inflammation* caused by exposure, or *dyspepsia.* I am inclined to the belief that dyspepsia must come first, or some degree of it, for I can hardly conceive of a case of consumption where the patient always had a good stomach.

Hopkins.—That consumption occasionally is, and often may be prevented from occurring in children hereditarily disposed, I have no doubt. I believe the especial means to this end are not one, nor few, but many; and that their *combined* action is, in general, essential to the attainment of the end aimed at. Foremost among these, I judge, should be placed what may be termed *discouragement of hereditary habit.* I mean by this that if the parents of the individual have attained the peculiar physical habit that tends to the deposit of tubercle under certain given conditions, social and professional, the children should as soon as possible be transferred to conditions that shall bring into habitual exercise other qualities, i. e., conditions contrastive, and therefore re-active as regards the inherited crasis, e. g., that which is by inheritance intellectual and luxurious may, while duly watched and nursed, be educated over to that which is physical and hardy. The same contrast from native conditions can be measurably carried throughout the social scale. There can be no more potent alterative of temperament and nutrition than this. And as to climate, the systems of these individuals are so impressionable that much is often attainable by mere transference from city to country, from valley to highland, &c. But these stages are requisite *early* upon the first *suspicion* of taint. The remark of a musical artist to an accomplished pupil whose studies were completed, "Now go and learn the cooper's trade" is in point here. The second great means upon which I beg leave to touch is, a more happy and thorough dissemination of physiological theory; a better indoctrination of families and schools in all those great principles upon which are based the laws of health, and upon which the physical structure of society will rest whenever the members of society shall be generally intelligent on these matters. Physicians, both in the family and in the community, have great opportunities here which are sadly ignored by too many. The texts-books in physiology adopted by most of the schools are unsatisfactory. But in the *family,* not in the *school,* must we look for the pursuit of that good study, and for the fruit of it. I am persuaded that most generous and universal use of milk and of unbolted cereals is of cardinal importance, and, if habitual, would be of inestimable value in

conjunction with meats and the saccharine fruits and with butter. Pastry should be excluded. It is possible, too, that cod-liver oil has been too long acknowledged as king; and that it will serve better as adjuvant. In a case not consumptive in which digestion and assimilation were extremely imperfect, I have found so much satisfaction from the use of pepsine and lactic acid, combined with soluble citrate of bismuth and sirup of orange-peel, that I am induced to allude to it here, as being a digestive agent worthy of trial in cases that can afford the expense. Another suggestion is, the adoption of means for inducing ozonized oxygen in apartments and localities. It seems abundantly proven that simple ventilation, at least in cities, does not supply a feeble organism with its requisite atmosphere. But the air becoming, as it were, vivified by ozonization, becomes at the same time disinfected of whatever may have been deleterious. The contribution of well-regulated and restrained athletic sports toward the end now discussed, needs no more than an allusion. The universal *croquet* tempts to its pursuit in low-necked dress and thin slippers after dew-fall; I know of no other objection to it. Questions nine to eighteen have all reference to influences of an exhausting nature, and might, with more or less qualification, all be answered in the affirmative.

The following, from an eminent London physician, I have been unwilling to divide under the different questions:—

Third question: In a large family, a member of which I passed for insurance, where the hereditary tendency existed in both parents, the elder children, being poor, had to rough it, and remained healthy; while the younger, having meanwhile become wealthy, were coddled, and so became consumptive. In another case a sea-life appears to have checked an early tendency to tuberculosis of lungs.

Eleventh question: Dry grinding produces fibrous phthisis—"grinder's rot." Wet grinders do not seem to suffer, at Sheffield.

Tenth or twelfth question: The most pernicious overwork I know of in respect to the production of phthisis, is that of the Cornish lead-miners, who after their day's work, have to climb an exhausting number of ladders. They become consumptive in ordinary pits; but where a "man-engine" is used they are preserved.

Fourteenth question: The most frequent of all causes among all classes in such a population as that of London, and probably the most powerful cause, for it acts even in spite of hereditary health. The course of events connecting sorrow of mind with disease of body, would seem to be—slow breathing, defective innervation, and consequent weak action of the heart, slow circulation in the stomach, imperfect supply of gastric juices, anæmia, malassimilation of fibrine, formation of tubercle.

Fifteenth and sixteenth questions: A balance is struck; pregnancy seems to check, child-birth and suckling to hasten consumption.

Seventeenth question: No; harlots are healthy.

I hope, Dr. Bowditch these answers are what you require. I do not exactly see what action a State can take in the matter, except by assisting everybody to be as wise, joyous, prosperous, as well fed, and as pleasantly situated as circumstances will admit. Perhaps they might in addition make celibacy compulsory in ascetics in order that the anæmia of parents may not produce tubercle in the children (see "Galton's Hereditary Genius"). But I suspect

that would be too violent an infringement of personal liberty for Massachusetts.

The following comes from a well-known physician in New York :—

Parker.—Third question: Such means as are essential to a perfect state of health—first, such food as makes perfect blood, as milk; second, breadstuffs; third, ripe fruits; fourth, meats. These must be taken in proper supply and at definitely prescribed periods. Where more is taken than is perfectly digested harm is done. When taken too frequently harm is done; that is, an imperfect digestion is the result. Again, the *health balance* must be maintained; if a given quantity is taken into the system every twenty-four hours, an equal amount must be excreted, or thrown off from the system; otherwise, effete material remains and the balance is disturbed. The effete material is worked off by the *lungs*, the *skin, kidneys, &c.* A pure and dry air the lungs *must have* in order to perform their part of the work. The skin must be clean, and active physical exercise is essential to the healthful physical working of all,—lungs, skin and kidneys.

Fourth and fifth questions: Yes; any circumstance unfavorable to the soundness of the system tends to induce consumption.

Sixth question: In some cases of strongly-marked consumptive diathesis it is overcome by alcohol, and the alcoholic diathesis takes its place, and life, such as it is, is prolonged.

Eighth question: There are cases of incomplete digestion in which consumption tends to occur. Now in these a *limited* amount of brandy or rum, taken *with* the food as *kindling material* in starting a common fire.

Sixteenth question: Child-bearing checks for a time, but does not cure. During gestation and lactation the appetite is often good and the digestion perfect.

Nineteenth question: Exposed locality of dwelling to sun and air, and on diluvial soil, is anti-consumption. I have very little confidence in any medication. Air, sun, and all the muscular exercise the patient *can endure;* if these induce appetite and digestion his chance for improvement, if not for recovery, is good.

This comes from one equally eminent resident at Chicago :—

Davis.—First question: I have no doubt but that consumption is often the direct result of hereditary influence. Third question: I am also fully of the opinion that children so predisposed can be made healthy, and avoid the disease by special physical training, begun young, and continued through active life, aided by dry, pure air. Fourth question: I am also fully satisfied that the habitual use of alcoholic drink, whether to the extent of drunkenness, or not, favors the development of consumption, both in parent and child. Several years since, I examined this subject carefully, and for six years kept records of cases and facts relating to it, the results of which I communicated to the Illinois State Medical Society several years since. I do not think total abstinence has any marked influence, except as it may be associated with good air, proper exercise, and food. In regard to questions nine to fourteen, I should say that consumption is rarely, if ever, caused by simple excess of mental or physical labor, but the confinement and over-

crowding of schools, neglect of physical exercise by students, the confinement and bad air in which some trades or occupations are carried on, undoubtedly cause a very large number of cases of consumption.

Seventeenth question: Excessive sexual intercourse or inordinately rapid child-bearing, like any other causes of debility, might hasten the development of consumption where the predisposition exists. Eighteenth question: The facts relating to the question of contagion or infection are so contradictory that I hardly have a positive opinion regarding them. Nineteenth question: If you mean by "exposure" of dwellings locations freely exposed to winds, and isolated, I think it has little, if any, effect upon the production of this disease. Twentieth question: Wet localities, damp rooms, damp air, and insufficient or imperfect exercise of the muscles of the chest and trunk of the body, are the most prolific causes of consumption.

The following letter from Dr. Manson, of Pittsfield, suggests important considerations in regard to the effect of diet, and especially of the free use of pork, even when swine are raised upon the farm where the family resides, and where the animals may be supposed to have been fed in the best manner. At any rate we may believe that they are not slaughter-house cattle, nor wholly offal-fed. But still more do I think that the three families tend to suggest the idea of the influence of contagion, or perhaps of improper food; and in support of this view I refer to Dr. Manson's second letter of later date, written in answer to one from myself, asking further information on the subject:—

PITTSFIELD, Maine, August 6th, 1871.

DR. BOWDITCH: *Dear Sir*,—I know of no better way to answer your inquiries than by relating, to the best of my recollection, the histories of certain families which have come under my professional observation. First, the family of S. J———, Esq., living in the town of P., came under my care some fifteen years ago. Mr. J. and wife were both from hardy pioneer stock; both living at the present time. Their parents, on both sides, lived to a good old age, according to the best information I can obtain. Said J.'s family consisted of three sons and five daughters. The eldest son died before my acquaintance with the family, I *believe* of consumption; both the other sons are now living in the State of Minnesota, I think, where they went years since on account of irritable lungs. They visit this State occasionally, but are feeble men, strongly inclined to phthisis, due I believe, to the incipient stage thereof. The daughters were named respectively, Mary, Lucia, Lizzie, and Martha. Lucia, first, after two years' suffering, died of consumption aged about twenty-three. Lizzie began to falter somewhat before the death of Lucia, but, in accordance with my advice, spent two winters—one in New Jersey and the other in Tennessee—with apparent benefit; lived some four years, and died aged about twenty. Two or three years subsequent to the death of Lizzie, Martha sickened in the same way, and died in about one year, aged about eighteen. About this time Mary, whose health had been, for some time, poor, began to fail rapidly, and died in about one year, aged

about thirty-five. *Location.* The house was on a hill, where all the surrounding surface was high and dry—much more so than their neighbors'—no unusual dampness in the cellar, drainage good all around; house large, two-storied, high-posted; rooms large and airy. Mr. J. was an independent farmer, worth some eight to ten thousand dollars; seemed anxious to do all he could for his family; had a *good orchard*, with *plenty of fruit*,—diet same as farmers in the State usually have. Their animal food consisted principally of *pork* of his own raising; family always comfortably clothed, the general surroundings were such as to conduce to happiness, nice flower-garden, etc., etc. The north and west sides of the house were protected by tall fir-trees, some thirty or forty feet in height, with thick foliage standing quite near the house—an artificial evergreen forest. How much this might serve to keep the back side of the building damp after a storm, might be a question.

The following table shows at a glance the history of the deaths by consumption in this family:—

S. J. & wife, both hardy pioneers, and their parents were long-lived.

1. Son; think died of consumption.
2. Son; now living in Minnesota, where he went because of an irritable state of the lungs; he visits here occasionally; is a feeble man, strongly inclined to consumption.
3. Son; believed to be in the incipient stage of consumption.
4. Daughter Mary; d. of consumption, æt. 35, after about a year's illness.
5. Daughter Lucy, d. of consumption after two years' illness, æt. 23.
6. Daughter Elizabeth, d. of consumption, æt. 20, after seven years' illness.
7. Daughter Martha, d. of consumption, æt. 18, after one year's illness.
8. Daughter.

All the sisters occupied the same well-ventilated room; but they successively took care one of the other.

Second Family.

Wm. C. P—— and wife, both living, aged about 55. The father of Mrs. P. is living—88 years old—smart and active; can split wood, care for cattle, &c.; says he never was sick. The mother of Mrs. P. died some four or five years ago, of old age, about 82; had suffered but very little from sickness during her life; had borne some twelve children, most all of whom are now living, *none having died of consumption.*

The father of Mr. P. was a tough, hardy man, never sick; died accidentally, aged about 60. His wife lived until some five or six years ago, and died of old age, nearly 90.

Wm. C. P. had six children, but one of whom is living,—*all died of consumption.* The eldest, a daughter, now living; married; has borne one child; is now in incipient phthisis; she is some 30 years of age. All the rest died between the ages of 16 and 22.

The house is situated upon *sandy* soil, at about the same elevation as those of his neighbors, a little higher than the village near which he lives; situa-

tion quite pleasant; soil so sandy that 'tis never wet, even during a storm; cellar was, as he says, never known to be damp—so dry, in fact, that the fine sand on its bottom has been so like ashes, and so troublesome, that he has sincerely contemplated cementing it on that account. Has always been in comfortable circumstances, having inherited a farm from his father, a very parsimonious man; family has been comfortably clothed, and fed from the farm. Animal food used has been, like the former, of *pork of his own raising;* varieties or extras never found their way to his table.

Tabular Summary.

W. C. P. & wife, both living, æt. about 55. Both of the parents of each lived to old age, strong and hale.	Children.	Grandchild.
	One daughter in consumption now,	"
	All the rest (five in number) died of consumption between the ages of 16 and 22.	
	The family lived on a dry soil; had little variety of food; meat consisted chiefly of pork, from swine raised on the place. The sisters slept with one another.	

Third Case.—W. S——, of this town, a hardy, tough man, living, aged 65; wife about the same age, died a year ago of consumption; a very hard-working woman, with no hereditary taint on either side; seven children; all but two have died of consumption; they are the youngest, but are now suffering from the same disease, aged 18 and 24. This family has lived until within a few years in comparative poverty. They may not have really suffered from the *quantity* of food, but I think they have from the *quality;* they have been coarsely, sometimes scantily, clad. The *meat used by the family has been pork.* The house is situated on the top of a hill, higher than more fortunate neighbors; location quite dry, but perhaps not *so* marked in this respect as the two previous ones, yet not wet; is dry more weeks of the year than most of their neighbors'. Deaths have occurred between 18 and 30 years of age. Two daughters have married and have children.

These three cases occur to me at present as striking examples of phthisis occurring in dry and elevated localities in the absence of hereditary tendencies. One fact I should have stated; viz., that Mrs. J. and Mrs. S. were *very hard-laboring* women, *particularly so during maternity, overtasking themselves* almost *daily,* as they acknowledge. Possibly this may account in part for the feeble constitutions of the children.

I subsequently wrote to Dr. M. asking more details in regard to the situations of the houses of these families, &c., and received the following reply:—

I have gathered some *facts* concerning your inquiries, believing that theory—hypothetical—had governed full long enough. I have lately visited the family of W. C. P., of whom I wrote you, and found the cellar *just as represented, dry like ashes—sandy*—never known to be wet soil around the buildings—sandy—perfectly dry. Mrs. P. gives the following history of her family—prefaced, however, with the assurance that consumption is, and was unknown in her father's family, and also in that of her husband. 1st. Her eldest son died, in the West, from diseased lungs, aged twenty-four; as she could not see him after he sickened, she can tell but little concerning the

case. 2d. S., daughter, who commenced to fail, when sixteen, and died at twenty-two, being sick during the whole interval. 3d. F., daughter, died in nineteenth year, after two years' sickness: P., son, died, aged 18, after one year's sickness: I., daughter, died, aged seventeen, after two years' sickness. The sisters slept with each other to quite an extent, but in an open chamber, *well-ventilated.* P., always, or for years, roomed alone, and practised sleeping with windows lowered at the top. The mother feels sure that none of her children suffered from masturbation. When young were strong and healthy. All wore flannel next the skin—*home-made*—the greater part of the year—had *plenty of pork and mutton, with milk, butter and eggs, more or less fruit, etc.* Diseases, in each case, seemed to commence in the *throat.* Lost much strength and became emaciated, in each case, before commencing to cough or expectorate; a great similarity in all the stages of each case. In case of J. family, the sisters each cared for the other successively, and as near as I can learn, occupied the same room, *well-ventilated* and *large*; further than this I can add nothing concerning them to my former report. The S. family cared for each other, and probably some two occupied the same room most of the time. I long since embraced the opinion *decidedly* that consumption *can be communicated,* and in fact, is quite likely to be, where one occupies the same bed with a consumptive. A striking illustration has lately come under my observation: the patient died last week. He was born in Scotland, of hardy parents who moved to this country some eighteen years since. His mother gave me the following history:—

"I am sixty-four years of age; my husband is living, aged sixty-six; neither of us has ever been sick; have seven children, all hardy; never heard of consumption amongst the family connection, on either side. Robert (deceased) was thirty-three years old—boss-weaver in woollen-mill—always *hardy* and *tough*—married a Yankee, about three years ago—wife was sick when he married her—*her family was consumptive.* She had cough—after a few months, night-sweats, bad. Told Robert to sleep in another room, but he said he would not leave her. In fifteen months she died. About six months before her death, Robert began to lose his appetite, and falter. I tried again to persuade him to take a separate room, but he would not leave his wife until about three months before her death, when it became necessary to employ watchers. He had then commenced to cough and sweat nights; and constantly failed, till last night, when he died. He was a strong constitution man until he took sick."

One more case on this point: Mr. G., of a family of six children, *all* hardy —no consumption amongst connection—married a wife from a consumptive family; who, after a few years, sickened and died, after about eighteen months' illness. Mr. G. occupied the same room and bed during the first year of her sickness; his health then commenced to fail: got a cough—soon, night-sweats—and died, some six months after the death of his wife; his being the only case of the kind in his father's family. This case occurred early in my professional life, and made a decided impression upon my mind. Other cases I could enumerate, but these may be sufficient cause for my opinion as to the *communicative* quality of the disease.

I will mention that, in conversation with Mrs. P. as above, she remarked that *scarlet fever* and *diphtheria* were the causes of the disease in her family. As I attended them through these diseases, and knew that the same neighborhood was generally afflicted with those diseases at the time her children were—and some were much worse—I asked her why her neighbors' children

were not affected in the same way, some of whom were more severely attacked with those diseases, than her own children. She answered, "I cannot tell."

Now, my dear sir, I repeat that I am firmly of the opinion, after about twenty years' observation in this *consumptive district*, that this disease is *surely communicable*, and it would be almost impossible to convince me to the contrary. Concerning the *original* exciting causes I am at a loss; am sometimes inclined to blame scrofula for the whole thing, and if you, my dear sir, are satisfied that scrofula can be propagated by *inoculation*, why not by *inhalation?* I believe it is so produced by inhalations of exhalations from the lungs and body—but this opinion is somewhat timidly expressed by an obscure country practitioner, striving for reliable information in any matter conducing to the physical betterment of suffering humanity.

In *connection with the use of pork*, I submit the following statements from Rabbi Dr. Guinzburg, a gentleman well acquainted with the various congregations of Hebrews in this city. Under date of October 29, 1872, he writes, in answer to some questions I proposed to him, the following replies:—

1st. The number of Jews living in Boston, is about 5,000.

2d. There certainly have not died of consumption, during the last five years, more than eight or ten Jews in the various congregations.

3d. It is very seldom that any Jew eats pork.

Dr. G. adds, "In order to give you as good information as possible, I did not rely upon my own knowledge, but made particular inquiries of those whom I thought able to give me good information upon this subject."

If Dr. Guinzburg's data be correct, they show a very great immunity from consumption on the part of the Jews, compared with the citizens generally, as will be seen by the following comparison between these numbers and those procured from the Registration Reports published by the State. In the Report published 1869, page 64, we find that, for the five years preceding 1869, the annual average of deaths by consumption, was 338 for every 100,000 living. These data from Dr. Guinzburg and the State Report, give the following table:—

	Proportions of deaths to 100,000 living.
All religions, ...	338
Jews, ...	40

These statements from Dr. Guinzburg are confirmed by the following letter from Dr. A. Haskins, of this city. Dr. Haskins is connected with one of the Jewish benevolent associations for the benefit of the sick. I sent to him similar questions and make the following extracts from his reply :—

"I am generally employed in about sixty (60) families (Jewish). I have had these families under my care for two and a half ($2\frac{1}{2}$) years. During this time I have seen but one (1) case of consumption. I have averaged among these sixty families, about two visits daily. In my other Jewish practice, which is not inconsiderable, I have in this time ($2\frac{1}{2}$ years) seen two (2) cases of consumption. * * * * I am sorry I have no statistics whereby I could compare the two peoples (viz.: Jews and Christians). I can, therefore, give you only my impressions. I should say that I find consumption less frequent among the Jews than among the Christians; this would be my own impression without any data to fortify it."

The following, from Dr. Waterman, also sustains the same idea :—

BOSTON, November 2, 1872.

DEAR SIR,—Excuse my delay in answering your note. I can give you no statistics, and fear that my information will prove to be of a negative character. I cheerfully give the following opinions, however. First, I have attended four charitable associations, numbering about 40, 50, 60 and 100 families. At present, I only attend one, containing 100 families, and on which I average a fraction over one visit a day. I have, besides, many private families among the Jews. Second and third questions.—I have attended but few cases of consumption, and I think the disease is not so prevalent as among Christians. I have seen some quick and rapidly fatal cases. Fourth.—The older Jews invariably abstain from pork, and most of the younger ones, especially those from Germany; those born in this country, also the English and Dutch, are not so strict, as a rule, in regard to this matter, nor in their observance of the fast and other holy days. I never knew a Jew to eat pork, *as such*, but I have seen them eat ham. I have met with two cases of tape-worm, in Jews, but know not whether the parasite came from pork, or beef, or other meat.

Truly yours,

THOS. WATERMAN.

Certainly, as it seems to me, these replies from Rabbi Guinzburg and Drs. Haskins and Waterman, indicate that consumption is rather rare among the Hebrews of this city. I cannot think that any physician in New England practising among Christian families, can make a report like that of Dr. Haskins, viz.: That in a practice so extensive as that which Dr. H. has had, and extending over two and a half years of

time, only three cases of consumption should have been prescribed for.

This apparent infrequency of consumption among the Jews, induced me to examine further, and a friend calls my attention to the fact that this people has not suffered from various diseases as other sects have. For example, they suffered, in the Middle Ages, but little from the plague: the epidemics of typhus in 1505 and 1824 troubled them but little; croup is also said to be rare. Boudin,* (from whom the above facts are obtained) gives the following for the relative liabilities of Schlaves, Germans and Jews, in reference to "plica."

29 ill, in 1,000 of Schlaves.
18 ill, in 1,000 of Germans.
11 ill, in 1,000 of Jews.

On the contrary, they are more afflicted with idiocy and insanity, in Denmark, as follows:—

3.34 insane or idiotic among Catholics.
5.85 insane or idiotic among Jews.

Unfortunately, Boudin says nothing in regard to their liability to consumption. This subject is altogether too wide for further remarks, at this time, but whilst these pages are in press my attention is called to the following facts mentioned by Dr. Stallard:—†

"The mortality of Jewish children under five years in Prussia is much less than of those in Catholic families. * * There is no hereditary syphilis, and scarcely any scrofula to augment the mortality. * * The mother undertakes no work that takes her away from her children. * * The average duration of life at Furth is twenty-six years amongst the Christians and thirty-seven among the Jews. * * At Frankfort, the Christians average thirty-six years and eleven months; the Jews, forty-eight years and nine months. In Prussia, the Christian population requires fifty-one years to double itself, but the Jewish population will double itself in forty-one and a half years.

* Traité de Géographie et de Statistique Médicales, et des Maladies Endémiques. Paris. Baillière, 1868, vol. 2, p. 141.

† London Pauperism amongst Jews and Christians, &c. By J. H. Stallard, M. B., London. Saunders, Otley & Co., 1867. London.

Wakefield.—Intemperance, according to my observation, causes death by apoplexy, hepatitis, ascites and anasarca, combined with hepatitis or erysipelas, &c.

Jarvis.—Some years ago when I was in practice, I had complete knowledge of all the ailments of a considerable number of families. I divided them, or rather their members, into two classes—the temperate and the intemperate—and compared their number of days of sickness for two or three years. I added to the intemperate sickness, all others caused by intemperance (as injuries to passengers, caused by overturning of stage-coach, driven by a drunken stage-driver). The result was 14 per cent. more days, almost, per person, among the intemperate.

Haskell.—There is one cause of consumption, which, I am confident, plays an important, though an insidious part, to which I have never seen any allusion made.* I have in mind at least four families, and more single persons, who were too proud to acknowledge, and too fastidious to endure, the sulphur purgatory, and who have harbored and nursed the itch until it became chronic, and either the irritation of the skin, or the roundabout methods they adopted to deaden it, have so broken the general health that they have rapidly gone into consumption. I have a strong impression that this odious evil is a frequent precursor of the more fatal malady. In the case of many a college student, whose untimely death has been lain at the door of *hard study* the *itch* has been robbed of its share of credit.

Collins.—I am a native of America; was graduated in medicine in '43; was connected with the public medical institutions of the city for ten years; served three years in the hospitals. In 1849 my health gave way, and consumption was developed. I left the city for the Island of Madeira, where I spent the winters of '49 and '51, four months, on the island. I then went to Spain, France, and England; was abroad one year. On my return I desired to find some dry, elevated region, where I could breathe better and cough less than in New York city. Having tried various parts of the United States, I finally selected the south-west corner of Massachusetts, eighty miles from Long Island Sound, 850 feet above tide-water, protected on the north and east by a beautiful mountain range. The Housatonic River flows rapidly through this portion of the valley. No swamps, nor low ground; an abundance of pure, soft water. Now this is the same relative protection that the city of Funchal (Madeira) has, and Malaga, Spain, and Nice, in the north-west part of Italy. The natives here (in Great Barrington) are healthy, and I very seldom meet with a case of consumption which originates in this region. I have been here twenty years, and have long since gotten rid of my pulmonary trouble.

The following letter, from Dr. Bartlett, suggests the importance of trying to get a radical change of climate or of telluric influences, by even a small change of location. Many dread the exile from home required by a Southern or Western resi-

* Unless the psora of Hahnemann be an exception, which he makes the cause of all diseases.

dence; many more are too poor to travel; but very many may be able to move the short distance from a wet place to a dry, warm slope. And Dr. Bartlett's letter suggests hope to such:—

CHELMSFORD, February 27, 1872.

DEAR SIR:—Knowing your interest in the influence of locality upon tubercular disease of the lungs, I have thought that it might not be uninteresting to you to receive the history of a case which I have been watching for some years, in reference to this point. A young lady of this town, whose mother died of rapid tubercular disease of the lungs (said to be congenital), and whose father died from pulmonary abscess, resulting from pneumonia, the recurrence of the abscess being frequent for seventeen years, manifested in a marked manner. All those indications which we at times notice in the young female seemed to show that her life would early be brought to a close, as her mother's had been. So strong were these indications that I earnestly advised her step-mother not to sanction an early marriage; but love proved stronger than preaching, and she married and went to live upon the highlands, known here as Robin's Hill. The result has been that all the symptoms of phthisis have entirely disappeared, and it would be difficult to find a healthier woman than she is now, after having borne three robust children. In the course of my inquiries I have learned one fact which it might be desirable to know, viz.: that no case of consumption has ever occurred in any of the families living about this highland. I think that many families, living in dread of the ravages of that terrible destroyer, might here find robust health, instead of being driven away from home to Minnesota and other wild regions of the West. At any rate, I think the experiment might be worth trying, and with every prospect of success. I know that in many cases patients dread the going away from home and its comforts, and if we have at our doors places where health and home may both be secured, at a cheap rate, many a life may be saved without the necessity of an expensive and tedious journey.

Yours, with respect,
JOHN C. BARTLETT.

I submit, almost entire, the following, from one of the oldest and most respected physicians of Maine:—

TOPSHAM, ME., November 19, 1871.

DOCTOR BOWDITCH: *Dear Sir*,—Since receiving circular of July I have reflected much upon the queries and suggestions therein proposed, but am fearful of my ability to impart any decided benefit to the cause you are engaged in, by any practical responses from my own experience. I have resided between fifty-one and fifty-two years in this town. In that time I have witnessed almost every form of consumption, and almost everything else which usually falls to the lot of a medical man. Beside my home practice I had a tolerably wide circle of consultations in Lincoln, Cumberland, and several other counties upon the eastern shore, and the regions watered by the Androscoggin and Kennebec Rivers. I feel strongly impressed with the belief that consumption, typhus and typhoid fevers are, in proportion to our population, much diminished from what they were half a century ago; so, too, are colic and cholera morbus. So far as my experience and personal observa-

tion go, consumption is far more frequent among the females than the males. The cause of this, no doubt, is to be looked for in the different habits of the sexes, chiefly in regard to out-of-door life, and also to the stronger sympathetic and emotional character of women, especially young women. I have been looking over my notes and diaries for a long time back, and I find the general tenor of my belief to be, in relation to the causes of consumption and its remedies, all in one direction. As Dr. Bowditch suggests a wish to receive "bits of family and personal history," I will, as briefly as possible, give that of the P. family, of this town, a name well known in the Atlantic States, North and South, and in Western and Northern Europe, wherever a cotton-ship was able to discharge her freight. It will epitomize a large class of cases of consumption. About one hundred and twenty years ago a young married man moved into town, and there were born to him, I think, five sons and three daughters; the sons were R., A., T., J. and D. The sons all lived and died in town, and in the immediate vicinity of where they were born: one of the sisters also; the two others lived and died in the adjacent town of Bowdoinham. I am not positively cognizant of the mortuary record of the families of the two sisters who lived out of town, but I am of the opinion that two or three cases of consumption occurred among them.

The following table, drawn up from the verbal statements of the writer of the letter, presents a more distinct view of the hereditary character of the process of consumption in this family than can easily be obtained from the letter itself:—

Original Stock.	Children.	Grandchildren, habits, conditions, &c.	Great Grandchildren.	Great Great Grandchildren.
This family moved into the town 120 years ago and had five sons and three daughters.	Robert died upwards of 80, of old age.	Son, died of consumption. Son. Son. Daughter (Mrs. Hunter), died of consumption, Daughter. Daughter.	Twelve children, 5 died infants, 7 adults. One daughter far advanced in consumption, married cousin, both husband and wife died of it,	Daughter consumption. Daughter consumption.
	Acton, died, not consumption,	Several children, *none consumptive.*		
	Thomas, no consumptive signs, died at 80, of cancer; wife died of consumption,	Son, cough, hæmoptysis, &c., but lived to 82, active; his wife grew stronger child-bearing, Son, 82, alive and well. Son, asthmatic all his life, alive at 71. Daughter, single, died of *consumption.* Daughter, married, died of *consumption.* Daughter, married, died of *consumption.* Daughter, single, died of *consumption.*	All his children alive and well.	
	Joseph, drowned,	Son, } twins { *consumption.* Daughter, } twins { *consumption.*		
	David, died, consumption,	Daughter, *consumption,* Daughter, typhoid fever. Daughter, puerperal fever. Son, consumption, married cousin. Son, sea-captain, alive, age 65.	One man child alive and well, age 50.	
	Daughter, Daughter, Daughter,	About the precise history of two, not much known, but *thinks one* or *two* cases of consumption among them. No consumption reported in the third.		

"The summing up of the teachings of these three generations of the P. family is as follows: First. The first question that naturally presents itself, is, Does this family history furnish evidence of hereditary predisposition to consumption? I would answer, Yes. Perhaps some would cavil at this, and ask, Why has not the family of A. P., with a larger family of sons and daughters, contributed to this consumptive catalogue, as well as those of his brothers, Robert Joseph, Joseph Thomas and David? It is not necessary, I take it, that every individual or every family should have such an obituary to establish the generally received truth of what is here affirmed. It has been my lot to have resided more than half a century in a community, where, eighty-five years ago, a family lived, and intermarried with cousins, in which insanity had shown itself. Among their descendants we find many families totally exempt from this terrible inheritance; while every now and then a case crops out in a branch which for generations, had not produced a person who has had insanity. I do not, of course, deny that other elements enter into the problem, and which have had a vast controlling power in bringing on or working out consumption,—moral causes, for instance; particularly, depressing influences. In T. P.'s family, the mother lived to see her sons come to manhood's estate: of the four daughters, all of them were in early womanhood at the decease of the mother,—the oldest was about twenty-four, the second, twenty-two, the third, eighteen, and the youngest, fifteen. The mother was a strong-minded woman, and in raising up and training her family, had the larger share of parental influence. Her death was, of course, a heavy blow. The boys, however, were just going out into the world, and mingling energetically in its busy scene; and by this means were somewhat removed from that extreme poignancy of grief at her death. Far different was the case of the daughters,—trained up as they had been, and learned to look and lean affectionately upon their mother for counsel, for sympathy and support, they felt her death as an irreparable loss, and so it was in truth; and not unlikely from that day they began to droop. The old homestead, to be sure, was still the seat of a generous hospitality; but to these gentle spirits, *their world* was the old hearthstone and the family circle; but what were these without their mother? And their brothers, also, gravitating, from other attractions, into different spheres.

These girls, when I first knew them in 1820, were neither sickly nor scrofulous,—they were smart, energetic, and, to all appearance, healthy. The eldest possessing the good housekeeping capabilities of the mother, took her place in the family. The second daughter was the most fragile of the sisters; tall and graceful, her features were somewhat pallid perhaps. The third daughter (she who died first) was accounted the most intellectual. Four months before her death she was, to all appearance, healthy; her facial expression was good. The roses and the lilies showed a fair admixture; and her activity and muscular movements betrayed no ominous indication of disease. The first and second daughters, Dr. N. Smith visited with me, several times; this third daughter, I believe I mentioned, became brain-affected, I presume from tubercular deposit. The youngest girl, had it not been for the sad death of her sisters, would, I think, have been the most brilliant.

Second. As to the therapeutical department, if I may say a few words. It would seem as if the most exhaustive efforts have been made to discover the means, as far as the Materia Medica is concerned, to combat consumption and to cure it. The four quarters of the globe, and every island, ocean and sea (save the yet unrevealed open Polar sea) have been ransacked for material aid. But for long, physicians have been much inclined to abandon

drugging. The Homœopaths still professedly have faith in copious dilutions; the Hydropaths in cold water: then there are the Mesmeric doctors, the vegetable Eclectics and the Electric experts in a medical way; all of these have pushed their claims for success, but the more intelligent the masses of our people become, the less will their faith be in these interested claimants for public notoriety. But aside from such as rest their claims for skill, upon a collegiate diploma, there is a vast horde of disreputable men who have entrenched themselves around the Patent Office, and who are constantly sounding their trumpets in the columns of every newspaper. There are very many thoughtful men, *outside, and in* the profession, who strongly believe that the way out of this labyrinth of professional mysticism and superstition will yet be pointed out by some philosophical and practical medical man. Perhaps the time is far distant when the correct pathology of what we call consumption, will be determined and accepted. But may not the laws of the imaginary Hygeia become so truly and faithfully established as to demonstrate the sources of danger, and thus enable one, who devoutly looks to his pathways in life before he leaps, to escape the danger of destruction? Some, perhaps many, of our recognized diseases may disappear; and new ones takes their places, perhaps, so that (if I may use the terse and sententious language of Bunyan) while "one escapes to die, another is taken to live."

Very respectfully,

Your humble servant,

JAMES MCKEAN.

The following facts and opinions are contained in a letter from Dr. C. G. Rothe, of Altenburg, in Saxony, Germany :—

Of twenty-seven cases of pulmonary consumption which came under my care during the last two years, there were

Caused or promoted by	hereditary influences, ...	4 cases.
" " " "	trades (1 miller and 4 cigar-makers), . .	5 "
" " " "	exposure to cold and damp weather, and by damp and cold dwellings in tenement-houses, void of sun and air; and in shops,	18 "

The latter 23 cases being of the age from 21 to 46 years, all of healthy origin and of good health up to the time of the onset of the disease. All of them were taken suddenly by a severe, obstinate catarrh, complicated with fever, want of appetite and emaciation, while the physical signs showed chronic inflammation of the surrounding portions of the lungs, mostly in the upper parts, but in some cases in the lower lobes, while the tops remained intact. This inflammation used to spread more or less rapidly over the whole side of the infected lungs, sometimes over both, and ending, in all cases but four, in the "caseous degeneration" of the parenchyma of the lungs and death after three to six months. In four cases the progress of the disease has been checked to the present day, through the inhalation of carbolic acid with tincture of iodine; in three of them all the physical signs have gradually disappeared, and their health seems to be totally restored; the fourth, a married woman, 32 years old, being constantly exposed to damp and cold in a

hat-maker's shop, had two relapses, and is now, two years after the first severe attack, lying down hopelessly. The inhalations of the carbolic acid had no beneficial effect on the hereditary cases of *tuberculous* consumption; and in those cases of inflammatory origin, where miliary tubercles set in, in the course of the disease, and where the disease spread below the insertion of the bronchial tubes, internal remedies such as cod-liver oil, hypophosphates, all proved of no avail. Drunkenness, sexual indulgence, and overstudy have not been noted amongst the causes of the disease. In children the disease has not been observed, except in one girl, three years of age, who, two months after a severe attack of diphtheria, of which she was cured by the carbolic-acid treatment, died after nine days' illness with all the signs of acute tuberculosis. I have excluded this case from the above table because the denial of the post-mortem examination left the diagnosis uncertain. Among the four cases of hereditary tuberculosis there is one of a pregnant woman, in whom, during the stage of pregnancy, the disease developed itself with great rapidity, progressing, at the same time, in the lungs and larynx, so that she was for six weeks totally aphonic. She died three days after her delivery. I am of the opinion that much can be done towards the prevention of this fearful disease by close attention to every "slight catarrh," at its first onset.

C. G. Rothe.

Altenburg, October 31, 1871.

THE ADULTERATIONS

AND

IMPURITIES OF FOOD.

By H. B. HILL,
Assistant in Chemistry, Harvard College.

THE

ADULTERATIONS AND IMPURITIES OF FOOD.

Confectionery.

There seems to be a popular opinion prevailing that the only injurious substance which confectionery is likely to contain is *terra alba*, or sulphate of lime. From the present investigation, however, it would appear that the adulteration with *terra alba* is of little importance when compared with the common use of poisonous coloring agents. While 94 per cent. of the articles examined were found free from *terra alba*, 46 per cent. of the specimens of colored confectionery contained active mineral poisons.

The colors most frequently seen in the shops are the various shades of red and yellow,—less frequently the blues and greens, and among these the reds and browns are the only ones that are likely to prove harmless. In the yellows and greens poisonous metallic compounds are the most convenient and permanent coloring agents, and are therefore most commonly used.

No simple and ready test offers itself for the detection of injurious substances in confectionery, although for many articles a little boiling-water gives all the information that can be desired. The metallic coloring agents are insoluble, and those that dissolve are as a rule harmless. In all cases, therefore, where confectionery should contain nothing but sugar, this test can be applied with tolerable certainty, but it naturally loses its certainty when applied to confectionery that may properly contain, besides the sugar, insoluble organic matter.

The different samples of confectionery, all purchased in Boston or its immediate vicinity, were examined for mineral

adulterations, and the nature of the coloring-matter present was determined. They were also tested for starch, although no attempt was made to determine what form of starch had been added.

Seventy-seven samples of confectionery, both white and colored, were examined, and of these thirty-eight were found to contain starch. In most cases it was present in but small amount, but fourteen specimens contained large quantities.

In five samples *terra alba* or sulphate of lime was found. Three contained very little, and two a very large amount. In one of the latter specimens—a little sugar-toy—the ash, on ignition and subsequent treatment with sulphuric acid, amounted to 58.19 per cent. of the original weight, while good white sugar seldom leaves more than 0.1 per cent. of ash.

Of the seventy-seven samples examined sixty-seven were colored, and among them were twenty-one specimens of yellow, twelve of orange, twenty-nine of red, five of brown, seven of green and four of blue.

Of the twenty-one yellows, seventeen consisted entirely of chrome yellow or chromate of lead, two contained chromate of lead, although a vegetable yellow was also present, and two were colored with organic yellows alone.

Of the twelve specimens of orange, nine were colored with orange chrome or orange chromate of lead, two contained an organic red mixed with chrome yellow, and in one the coloring-matter was entirely organic.

Of the twenty-nine reds, twenty-five were organic, three samples of a brick-red color contained iron, and one was colored with vermilion or sulphide of mercury.

Of the five browns, four owed their color entirely or in part to the presence of iron.

Of the four specimens of blue, two contained only organic coloring-matter, and two were found to be colored with ultramarine, or silicate of soda and alumina with sulphide of sodium.

Of the seven greens, one, a pale green, was found to be organic, six were colored with a mixture of Prussian blue or ferro-cyanide of iron with chrome yellow, and one contained in addition arsenic green or arsenite of copper.

It will thus be seen that thirty-six of the seventy-eight pigments analyzed contained lead, one contained mercury, and one arsenic and copper.

The worst of the specimens analyzed will serve as an example of the poisons which may readily be brought together in the same article. It consisted of several mounted soldiers, gayly uniformed. The ground-work was pure sugar with no *terra alba* or starch. The red caps and the red trimmings of the soldiers' uniforms were vermilion. The yellow of their buttons and certain other parts of their uniform was chrome yellow, their blue coats ultra-marine, their cream-colored horses contained chromate of lead, and the grass over which they rode was Prussian blue mixed with chrome yellow, made brilliant with occasional patches of arsenic green.

As the confectionery generally took its color entirely from the poisonous metallic compound, and the quantity would therefore hardly fail to be injurious, it was thought advisable to make a more extended qualitative examination, instead of making a limited number of quantitative determinations. In one sample of yellow lozenges, however, which was, perhaps, a fair specimen of the more brilliantly colored yellow confectionery, the amount of lead was determined by my friend, Mr. Charles E. Munroe, assistant in the Laboratory at Cambridge. According to his determination the lozenges contained 0.13 per cent. of metallic lead. At this rate, ten of them would contain one grain of plumbic chromate, or fifteen one grain of lead.

A sample of a green coloring-matter used in tinting ice-cream, kindly sent me by Dr. H. K. Oliver, was also examined. By far the greater part of it was clay—silica, alumina, and a little iron being shown by analysis.

The coloring-matter itself was organic, and gave the re-actions of the aniline forms. The coloring-matter was slightly soluble in water, soluble in alcohol. The color was discharged by ammonia, and turned yellow by hydrochloric acid; moreover, ammonia was evolved on heating with soda-lime. No trace of arsenic could be detected. Whether the aniline colors may safely be used for coloring articles of food, even if they are free from arsenic, is a question that is open to doubt.

Pickles.

In addition to the adulterations to be found in vinegar, pickles are liable to be more or less contaminated with copper, which has either been added directly, or which comes from the copper utensils.

It is a matter of little difficulty to recognize the presence of copper in pickles. A fresh bright green color is usually a sufficient indication. Although copper is generally present in so small quantities that it can impart no color of its own, it appears to fix the natural green of the fruit, and prevents it from turning yellow or brown. The presence of copper may readily be confirmed by immersing in the vinegar poured off from the pickles, a bit of polished steel, as a knitting-needle, and allowing it to stand for several hours. All the copper, which may be present, will then be found as a metallic coating upon the steel, or if the quantity of copper be very small, the steel will have a reddish tinge.

Twelve samples of pickles, put up by as many wholesale dealers, were examined, ten of which were found to contain copper, and in these the amounts of copper were determined. From one to two hundred grammes of the pickles, with a fair proportion of vinegar, were incinerated, the ash was treated with nitro-sulphuric acid, and the copper precipitated by the battery and weighed as metal.

Nine of the samples were examined for alumina, and found to contain it, showing that alum had been used in preparing the pickles. The presence of sulphuric acid in the vinegar, therefore, gave no ground for supposing that sulphate of copper had been added.

The results of the analyses are given below. In the first column of the table will be found the description of the pickles as given on the label, in the second the weight of metallic copper in 1,000 parts, and in the third, for convenience of comparison, the number of grains of crystallized sulphate of copper in the pound to which the percentage of copper corresponds.

	Weight copper in 1,000.	Grains sulphate of copper to pound.
1 Gherkins, ...	–	–
2 "	–	–
3 Mixed pickles, ...	0.009	0.26
4 Superior pickles, ...	0.025	0.71
5 Chow-chow, ...	0.025	0.71
6 Extra pickles, ...	0.027	0.77
7 "	0.028	0.80
8 "	0.032	0.91
9 Gherkins, ...	0.035	0 99
10 "	0.039	1.11
11 "	0.052	1.48
12 Superior pickles, ...	0.077	2.19

The fourth, fifth and eighth samples were through inadvertence not tested for alumina—the rest were found to contain it.

Nos. 1, 2 and 5 were English pickles. The others were American.

THE HOMES OF THE POOR IN OUR CITIES.

By FRANK W. DRAPER, M. D.

THE HOMES OF THE POOR IN OUR CITIES.

The following Report embraces the results of a personal inspection of the house-accommodation and general sanitary condition of the poorer classes in eight of the large cities of Massachusetts. The writer desires, at the outset, to acknowledge the uniform courtesy with which indispensable official aid has been extended to him in the various cities during the prosecution of this inquiry.

Boston.

The inefficient policy which, for years, has been pursued by the city administrations in sanitary matters, and which has held sway in spite of the remonstrances of those who believed they saw the tendencies and fruits of such a course of indifference, has been demonstrated in no more tangible way than in the past and present condition of a large number of the dwellings of the poor. These homes of the laboring-classes in Boston, overcrowded, unfavorably located, unwholesome in their surroundings, constructed with little regard to health, have not been a credit to the city. It is not from lack of information on the part of the authorities that such has been the case, for these abodes of misery have been again and again described in official reports* and in less formal but no less impressive works† which have told the story of these habitations and of the legitimate influence on the health, the morals and the political purity of the community in which their continued existence is permitted.

The writer cannot add a single word or contribute a single fact to make the story, so often told, more graphic or more

* See, for example, previous Reports of this Board and the Reports of the Chief of the Bureau of Statistics of Labor in Massachusetts.

† Like Rev. E. E. Hale's sketch, "How they live in Boston and how they die there."

truthful. The characters of the squalid, unhealthy residences of the laboring and other poor in Boston have been so well delineated, that the public may be said to be now fully possessed of a true notion of their badness. Except to point out some of the features which distinguish the tenement-houses of this, the largest city in the State, and give them peculiarities demanding certain special methods of relief, this Report will not attempt a renewed presentation of the matter in detail.

The following localities and tenement-houses have been recently visited, and their condition was found to be unequivocally bad. Many of them are included in the list of places inspected by the Secretary of the Board in November and December, 1870, and found by him to be disgracefully unfit for human habitation.* A few of the localities mentioned in that connection have become changed, but the general condition of the tenement-houses of Boston is the same to-day as it was then, and presents the same attendant moral and sanitary abuses. The few changes that have been made are due, not to any sanitary zeal or prevision on the part of the city authorities, or to the active execution of any legislative measures, but to the natural encroachments of business, trespassing none too soon on quarters which should have long ago been demolished as dangerous nuisances. Thus, the infamous locality in Cross Street, known as "Stone's Yard," formerly the nest of squalor, disease and crime, has given place to a substantial structure for manufacturing purposes. But these exceptions are few in number and scarcely worth noting. The following list illustrates that the house-accommodation of the poor in Boston is miserably defective. The instances cited do not include all the bad dwellings, probably do not comprise all the worst ones, but they comprehend enough to show that something ought to be done speedily for their general reform.

105 and 107 Cross Street.
Young's Court.
Mechanic Court.
Blind Alley, rear 209 North Street.
Land's Court, 223 North Street.
Rear of 324 North Street.
Cook's Place, rear 390 Commercial Street.
Commercial Court, rear 476 Commercial Street.

* Second Annual Report of the State Board of Health, 1871, page 60.

Pond-street Place.
Institute Avenue.
54 Cross Street.
Keefe's Alley, rear 170 North Street.
Barber's Alley.
Alley from 362 North Street.
Cole's Block, rear 490 Commercial Street.
Utica Street.
Cove Place.
Shaving Street.
Rear 145 Kneeland Street.
Parts of Cove Street.
Rear of 298 Kneeland Street.
137 Beach Street.
Rear of 315 Federal Street.
Rear of 477 Harrison Avenue.
Sand's Yard, 483 Harrison Avenue.
Alleys from Jackson Avenue.
Holden Place.
Stanhope Place.
Wilberforce Place.
Smith Place.
62 and 72 Joy Street.
Rear of 69 Phillips Street.
Rear of 42 and 44 Phillips Street.
57 and 59 Barton Street.
Billerica Street.
Parts of Nashua Street.
28, 30 and 34 Lancaster Street.
126 Merrimac Street.
Alley from 132 Merrimac Street.
South Margin Street, Nos. 10 to 22.
Rear of 67 Pitts Street.
Rear of 71 and 75 Pitts Street.
Alden Court.
47 and 53 Portland Street.
Second Street, near Athens.
Granite Street.
Rear 118 Dorchester Avenue.
Silver-street Place.
Athens Street, near Second.
9 Silver Street.
Silver Street, between B and C.
61 and 63 Gold Street.
Rear of 13 Swan Street.
27 and 29 Swan Street.
Rear of 583 Shawmut Avenue.
Rear of 634 Shawmut Avenue.
Basement and Privies at 634 Shawmut Avenue.
844-46 Albany Street.
Belmont Street.
Rear of 24 Pleasant Street.
Foot of East Lenox Street.
Baldwin Street.
Primus Avenue.
Johnson's Block, Meander Street.

Among the indirect causes of the present overcrowding of the tenement-buildings of Boston may be mentioned territorial improvements which have recently been made. The raising of the Suffolk-street district and the improvement of the Fort-hill section displaced a great number of tenants of the poorer class, without the substitution of any provision for their housing elsewhere, so that existing tenements in other parts of the city are filled to repletion. The reclaimed sections will never again become the sites of dwelling-houses of such a class as were removed; but, while these parts will not revert to their former condition of reproach, other parts have become increasingly objectionable, as a consequence.

The proceeding of the Lowell Railroad Company in taking, by special Act of the legislature, a large territory in Nashua Street, for the purpose of constructing a new passenger-station, has been followed by results similar to those just alluded to. The section embraced many tenement-houses,

occupied by the families of Irish laborers. In the carrying forward of the improvement these houses were all demolished, and their occupants were compelled to seek other homes. Thus the neighboring streets have received considerable accessions to their already surfeited condition, and great overcrowding is the result.

Other elements besides those mentioned have been continually at work to keep the demand for tenements a pressing one. Boston is an important port of entry for the immigrants who are constantly coming to America, in the hope of improving their condition. Many of these people are of the poorest sort, socially, mentally and morally. They at once settle toward the bottom of our civilization and become its dregs. They find homes where they can, and congeniality of surroundings attracts them to the cellars and the crowded rookeries, not alone as a temporary expedient until they can afford better things, but because also they have just left homes in nowise superior to these. In the courts and alleys of the North End five thousand Portuguese are thus collected. Italians, too, are there in large force. While the number of Irish who, recently arrived in America, have drifted spontaneously into these insalubrious quarters is not easily computed. It is the misfortune, not the fault, of these people that they can do no better; it is the fault as well as the misfortune of a city like Boston that it suffers such a condition to continue, in spite of laws and ordinances to the contrary.

It is not necessary to detail the faults of construction which are everywhere conspicuous in the tenement-houses of the metropolis. They are familiar to everybody who knows anything of the manner in which the poor live,—whether we take the small and dilapidated wooden shell at the North End, the dingy relic of a past, when its low-ceiled rooms sheltered a more aristocratic connection, or the more pretentious modern tenement-house, containing within its thin brick walls a perfect colony of people, the deplorable absence of provisions for healthful comfort is general. Ventilation and sunlight are not salable commodities, and have a very inferior place in the reckoning of the man of business, whose speculation looks to the largest possible returns from the smallest possible outlay. He recks little of transom-windows, ventilating-shafts, cubic

allowance of atmosphere, open ground-space in front and rear, and readily takes advantage of any indifference on the part of the authorities to evade the carefully-drawn ordinances which would compel a different course. If his building is barely safe, and the inspector says it will not tumble down about the occupants' heads, there is slight inclination to do more with a view to prolonging the lives of the tenants. Thus old buildings continue, with their dark bedrooms, their wet and mouldy cellars, their insufficient water-service, their lack of ventilation, and new buildings emulate their elders in faulty sanitary construction.*

If we were to indicate one feature of the tenement-house evils more conspicuous for its offensiveness than another, we should name the privies before all others. These essential appurtenances are almost uniformly the prolific source of nuisance. Especially is this the case if, as generally happens, there is community in their use. Under such conditions they are unexceptionally filthy. Where a single privy is made to serve the needs of a number of families, none of which are particularly nice in such matters, there is very apt to develop about such a place an exceedingly objectionable state of things, which it is difficult to correct. The doors are left swinging, or perhaps there is no door at all; and, there being no responsibility as to cleanliness, there is abundance of uncleanness. The number of such indecent abominations about this city, loading the air with vile excrementitious odors, and contaminating whole neighborhoods, is very great; they constitute one of the chief evils with which the health authorities have to contend.

The remedy for this appears to be a simple one. Just as far as is possible let single tenements have their respective, individual privies, under lock and key as closely as the rooms of the house. There will then be responsibility, and the blame of delinquency can then be readily attached where it belongs. It is hardly possible that all tenements can have properly trapped water-closets, although such would be the best arrangement; but it is practicable that all privies shall connect with sewers, and, such being the law, the connection

* See Second Report of State Board of Health, 1871, p. 61. See also communication to "Boston Daily Globe," Oct. 25, 1872, for illustrations.

ought to be compelled as fast and as far as may be. To fulfil the double purpose of providing a privy which shall not be open to community of use, and which at the same time shall be the least liable to evils that, under the best regulations, cannot fail to excite inconvenience and complaint, the form of apparatus recommended by the board of health of New York city seems the best. It is that of the trough-privy, constructed best of brick and cement, with the necessary inclination toward one end, at the outlet of which a substantial iron grating is placed to prevent any obstructions from passing into the sewer. At the upper end, the proper flushing arrangement is adjusted, and the rain-water from the roof and the sink-drainings from the house could be made available for this purpose in addition to the aqueduct-service. Such a privy has been in use for some time in connection with a large tenement-house of this city, and it is satisfactory after prolonged trial. It is easily managed, and not liable to get out of repair.

Waiving many other themes in connection with the tenement-houses of Boston, it remains to be said that there is the promise of a better future with regard to their sanitary regulation. Very recently (December, 1872), the legislative department of the municipal government has felt compelled to obey the unequivocal and almost unanimous popular demand for a reform in the sanitary administration of the city and has ordained an independent board of health. This is not the place to enter into any criticism of this new plan, but we cannot help regretting that the departments of street, alley and passage-way cleaning, and of the removal of house-offal, and refuse materials have not been put in their immediate charge. It is to be remarked, in view of the responsible task to be undertaken by the board in Boston, that its appointment is not premature. It is a step in the right direction, which may well be followed by every city in Massachusetts.

Fall River.

The many mills of this prosperous city have attracted to it a great number of people, whose livelihood depends, directly or indirectly, on the activity of the manufacturing industries.

Thousands of Irish and of French Canadians are to be found here, constituting a considerable proportion of the population. They are not all self-maintaining; it is inevitable that with such a population there should be mingled a class of the very poor, the idle and the shiftless.

It is evident, on the most cursory inspection of the tenement-houses in which these people live, that the confessed need of suitable house-accommodation in Fall River is not overstated. The city is overcrowded; there are more people than can be healthfully housed within its limits. The numerous influx of mill-operatives within the last few years has answered the demand of the corporations for more labor, but the mills have not supplied the needed dwellings.

The legitimate consequence of this overcrowding is that rents are high, and those who must work hard to make their financial ends meet at all, must resort to various devices to help their insufficient incomes. Many tenants take boarders, filling their attics and spare bedrooms as uncomfortably full as possible. Many others follow another plan; it was not an uncommon thing, in the course of the inspection of the poor quarters, to find a family renting a tenement of three small rooms for ten dollars a month, and sub-letting, for seven or eight dollars, one of the two bedrooms to another family, equally large, who provide their own furniture (scanty enough at that), but who are permitted to cook their food on the stove of the petty landlord and to eat their meals at his table. Thus, the original lessee reduces his rent to a very moderate figure, and cares little how many laws of health he may set at defiance in his efforts to get on comfortably and with the least wear of mind and body.

While this unfortunate condition of overcrowding, due undoubtedly to the improvidence of some of the mills, forces the lowest class into the meanest abodes and entails numerous abuses thereby, the accusation cannot be brought against all the corporations. There are many whose tenement-buildings will compare favorably with those of any manufacturing city, and it is noteworthy that new mills (as, for example, the Flint Mills) are careful to provide for their employés suitable dwellings whose construction is admirable.

Another fact, in which the mill-corporations are concerned

as affecting the sanitary welfare of the laboring-people in their homes, is the practice of advancing money to builders and small capitalists, who complete the buildings and refund the advance by partial or entire lease of the premises for the use of the operatives of the mill. This leads inevitably to overcrowding and to abuses which must attend such ambiguous and irresponsible lesseeship; there comes greater or less indifference to the wants of the tenants and to the proper care of the buildings and premises.

In the course of the inspection of the tenement-houses in this city, many instances were found which violated the plainest sanitary laws and called for speedy interference. It is not deemed necessary to describe in detail all the localities visited, but attention must be called to some of the more significant cases.

In Ford Street, was a wooden building called "Covell's Block," which was leased by the Crescent Mills and occupied by the operatives of that corporation. It contained eighteen tenements of three rooms each. The tenants were French Canadian and Irish, and each nationality was very ready to charge the other with causing the abominations which were only too obvious to sight and smell. The tenements were overcrowded; in one was found a family of twelve, five of the children of which slept in one of the bedrooms. There was no water-supply on the premises; the tenants were obliged to resort to a pump in the yard of a neighbor. The sink-drainings were thrown on the ground beneath the windows. The privies were nasty beyond description.

At No. 11 Sixth-and-a-half Street, was a wooden tenement-house. In one tenement of four rooms, fifteen persons found a home. In each of two attics, with sloping ceiling under the roof, the extreme height being seven feet, six adults slept, a single window, tightly closed during sleeping-hours, keeping out the air.

Adjacent was a tenement of three rooms in which ten people kept house. The rent of this tenement was ten dollars a month; but the tenant, by letting one room with certain stove and table privileges, reduced the rent of the two remaining rooms to three dollars, at the expense of domestic comfort and possibly of domestic harmony.

At the corner of Eighth and Bedford Streets, "Harrington's Block" was visited. The windows of the bedrooms of half the house were closely against the dead wall of the house next adjacent, and there was no chance for light or air. The sink-drain emptied its contents on the ground directly under these windows and the stench therefrom was represented to be intolerable, sometimes compelling the closure of the windows. The cesspool, into which the drain should have led, was full. The vaults in the yard adjoining were full and their contents had overflowed the wall and poured out on the ground; the privy's condition was in full harmony.

Many of the families in this block took boarders, crowding the sleeping-rooms to their utmost capacity.

At No. 1 Thurston Avenue, a dilapidated wooden shell gave residence to four Irish families. The rent was collected by an agent who never heeded complaints. The sinks were thoroughly unserviceable, the walls were broken, and the whole building was unfit for human habitation. The rooms were all too full; one bedroom had six occupants. In the yard there was various and plentiful filth.

"Lord's Block," at the corner of Wade and Second Streets, demanded attention for its filthy privies and its overcrowding.

At No. 89 Spring Street was found a basement tenement of two rooms, containing a family of five. The single bedroom for this family was without window or other provision for the admission of light and air, except the open door.

At No. 66, in the same street, another cellar was visited; it was occupied by a family of four. The front room or kitchen of the tenement measured 12 by 14 feet, and the two bedrooms, 6 by 8 feet, the height being seven feet. Each of the bedrooms obtained outside light and air through a dirty sash, twenty-four inches square. In rainy weather, the water entered the rooms through the wall of the house. The yard of this house was extremely filthy; a stream of night-soil from the overflowing vault joined a stream of sink-slops from the house and combined to make the premises indecent and dangerous.

The mother of this family stated that she suffered habitually from ill-health during last winter, while living in this tenement.

The region called "Barberry Hill," between Anawan and Washington Streets, was found so totally bad that it would seem invidious to select any particular part of it to specify as worse than the rest. It comprises many tenements, all of them overcrowded, and all of them so surcharged, without and within, with filth of all sorts, that it passes understanding how the numerous colony here established survives at all. Stables add to the unsavory aggregation of dirt, and a general air of decay and of miserable and nauseating filth is apparent on all sides.

An old wooden building, called "Smith's Block," situated on Anawan Street, at the foot of Pocasset Street, and at the outer limits of the section just alluded to, was a type of the worst of the tenement-houses; it was crowded, the rents were exorbitant, there was want of repairs, and there was dirt, squalor and misery. Windowless bedrooms, broken ceilings, dark and dangerous stairways, leaking roofs,—these were the features of this unwholesome building. Two families, containing nine persons, occupied one of these tenements on the coöperative plan, the original tenant paying ten dollars a month and surrendering one of his rooms for eight dollars.

At No. 48 Washington Street, a house consisting mainly of the cabin of some dismantled schooner and adapted to its present purpose by an improved roof and an outside stairway, gave a very satisfactory income to the enterprising landlord, and furnished homes to four families, at a rate varying from $6 to $15, according to the number of rooms. The smallest rent was derived from two little rooms under the roof, occupied by a recently married couple who were economizing and who really deserved better things. Their living-room was eight feet square and six and a half feet high. Their bed was made up each night on the floor of this room. The yard of this house contained all varieties of filth.

Lawrence.

This city is fortunate in the possession of unusual natural advantages of situation and soil, to promote the sanitary well-being of its inhabitants. The sandy foundation on which its buildings stand, does not hold the surface-drainage, to stagnate and slowly evaporate, and the cellars are dry. Its loca-

tion on a plateau of considerable height, gives it additional salubrity; while the swift-flowing Merrimac, and the two tributaries which join that stream within the city limits, afford abundant and most efficient provision for deeper drainage and for sewerage.

Undoubtedly these natural advantages have served greatly to give Lawrence its high place in the list of the healthy cities; its mortality ratio in 1870 being 1.72, in contrast with 2.43 for Boston.

It is greatly to the credit of Lawrence that not many tenement-houses exist within its limits open to censure on sanitary grounds. The worst features as regards filth, improvidence and overcrowding, were not observed by the writer at the time of his inspection, and in proportion to the population there were fewer of the abuses and evils pertaining to the dwellings of the poor, than in most other places visited.

But it could hardly be thought that Lawrence would be immaculate in these matters, with its large population of foreigners attracted here by its well-known manufacturing industries. Here, as elsewhere, grasping landlords exist who do not scruple to let uninhabitable premises, and who care little about the welfare or comfort of their tenants, provided the rent is paid. Here, also, are some tenants whose inherent tendencies appear to be toward the filthy and careless ways which beget nuisances in spite of any landlord's caution to the contrary. It is fortunate that certain conditions, whatever they may be, whether general prosperity, or municipal supervision, or the influence of example, keep within comparatively satisfactory limits the evils to which the poor in the large cities are subjected.

At 24 and 26 Common Street, three tenement-houses, two in front and one in the rear, were found in a very objectionable state. The largest of the three contained nine tenements of two rooms each. Its rear wall was close against the rear wall of the building next adjoining, so that the bedroom windows were practically useless. Its attic, under the pitch roof, was occupied by five people in two rooms. At the end of the house farthest from the street, were the well and the privy-vaults, the well being nearest the house and situated so as to receive the percolating fluids from the vaults and from

the sink-drains. The yard adjacent presented abundant evidence of the careless habits of the inmates.

Between the ends of the other two houses alluded to, was the privy for the tenants of those crowded quarters. It was located close to the windows on either side, with a view to economy of space, and with little attention to other important interests. Its interior was an abomination.

At No. 92 Lawrence Street, was a wooden block of eight tenements, called "Dolan's Block." It was greatly out of repair in all its interior, from cellar to attic. A basement tenement in this shell was let to an ancient Irish dame, who shared her quarters with her son-in-law and her adult grandson. Two rooms accommodated these three persons.

At No. 372 Common Street, a family of seven, including five adults, occupied two bedrooms, paying $7 a month for rent.

Undoubtedly the feature of the poorer tenement-houses of Lawrence most open to censure, was the apparently unquestioned liberty which was allowed in the occupancy of untenantable basements. There were many of these cellar dwellings observed in the course of the inspection, and, as compared with other abuses, they were out of proportion.

At No. 118 Valley Street, a basement of three rooms, of about six-feet post, furnished a home to a family of six persons. The bedrooms each had a small sash which was the only window. It was enigmatical how any air, fresh or otherwise, could find its way through this aperture. The rent of this cellar was $8 a month.

At No. 126 in the same street, a family of eight lived in a basement of three bedrooms and a kitchen, two-thirds under ground. Two of the sleeping-rooms shared, for their air and daylight, a sash of three panes of glass, an ordinary cellar-window; the third had a sash, two feet square, for itself exclusively. The rooms were seven feet high. There was no sink; the slops were thrown into the street.

At No. 136, a family of eight people occupied a cellar tenement almost identical in description with the last; and at No. 148, was a cellar seven feet high and seven-eighths under ground, with six occupants, who paid $10 rent. One of the two bedrooms had a three-pane cellar-window; the other had a more liberal allowance—nine panes.

At No. 36 Common Street, an Irish laborer, his wife and his three children lived in a cellar fourteen feet square and two-thirds under the ground. They cooked, ate and slept in a single room, and the whole five occupied the one small bed at night. There was no sink in the room. Two small windows were the only provision for ventilation and for the admission of daylight. Altogether the premises presented a most suggestive picture of misery. It was to the credit of the occupants that this single room, which was their home, was neat, and that poverty was not found incompatible with decency. The curse was that a man could be found grasping enough to let such a tenement, and that a city administration could be indulgent enough to permit such an act.

Although it is scarcely relevant to the subject, the writer cannot avoid alluding in terms of admiration to the tenement-houses owned by the great mill-corporations of Lawrence, and leased by them to their operatives, as an example of the fruits of an intelligent and liberal purpose to provide homes for the working-people which should merit the name; these extensive blocks of neat brick houses can challenge competition with any similar dwellings anywhere. The plan of their construction, the yard-room, the system of sewerage by means of a canal diverted from the river to run beneath all the tenements and take away at once all the sewage, the provision for the systematic removal of swill, ashes and refuse,—all these afford an example of what judicious and humane corporations, who have in view the sanitary welfare of their operatives, can do. Such results are of exceeding value for the sake of emulation, and even as a matter of policy, as promoting the productive energies in the tenants; by preserving their health and so economizing their vigor, they justify a thousand-fold the expense of their elaboration.

Lowell.

The health authorities of this city have been stimulated within the past two years to unwonted efforts to improve the sanitary condition of the whole community. An epidemic of small-pox, severe and long-continued, turned general attention in 1870 to matters of public health; and a systematic

inspection of the city and a wholesome execution of the health ordinances was the result. The people were compelled, for once, to keep their premises more clean. Under the impulse afforded by the presence of a general epidemic, a salutary reform in all matters pertaining to the public hygiene of the city was effected.

This worthy work, although in a considerable degree intermitted since the time alluded to, has not altogether lost its influence, after two years. It is to be regretted that the commendable zeal manifested at that time of revival should not be of continued vigor; it had its immediate reward in a manifest improvement in the condition of the poorer classes and in the mortality rates for the years in the interval.

In common with all the rest, the homes of the poor experienced the beneficial effect of this vigilance in sanitary matters, and the evidence is absolute that the abodes of poverty in Lowell, the premises around which more than any others the squalor, the filth and the misery of overcrowding lurked, are to-day comparatively free from the extreme abuses which prevail in some other localities in Massachusetts.

The dwellings of the mill-operatives, of whom there are so many in Lowell, are to be excepted from any unfavorable comment; for the manufacturing corporations exercise a most efficient supervision over the tenement-houses of their employés.

But the vigor which characterized the administration of the health affairs of Lowell two years ago will shortly forfeit its fruits unless it be renewed. The tenements of the poor, although in most respects relatively free from abuses, are beginning to show the inevitable tendency to relapse toward their former state. In three localities which the writer visited, there were present conditions requiring the attention of the sanitary board for their immediate or prospective reform.

In Middle Street were seen a series of wooden tenement-blocks of one story each. The tenements consisted of two and three small rooms, and they were all too full. Many of them were unfit for human habitation, from lack of proper conveniences or from want of general repairs. Two of the

52

blocks had basement dwellings almost entirely below the level of the street, and approached by a steep and broken stairway leading down to the damp area in front of the doors. These cellars were occupied by Irish tenants, who urged their poverty in extenuation of their occupancy of an underground dwelling.

The surroundings of these tenements were less objectionable than one might expect to find them. There was the usual privy adjacent, its vault full and very foul; but the yards were comparatively clean with regard to rubbish and swill. The alley at the rear of the houses was too low, too wet and too filthy to be conducive to health.

In William Street, some of the houses had very unwholesome back-yards, with puddles of stagnant water; ashes and rubbish had accumulated and the privies needed attention.

One or two blocks in Gorham Street, near Middlesex Street, were open to a like criticism.

In Winter Street were found several tenement-houses occupied by Irish people; these dwellings testified to the need of incessant watchfulness on the part of the health guardians in order to keep them habitable. Their sink-drains, privies and back-yards were by no means above reproach.

It is a gratification to report concerning Lowell that, with a few exceptions like those noted, the condition of the working-people was found to be comparatively satisfactory in their house-accommodation and general sanitary care. It demonstrates the benefit of efficient, energetic sanitary supervision, and it should stimulate the efforts to make the condition of the city much better than it has yet been. The ravages of the small-pox epidemic in all classes, deplorable as they were, can hardly be thought altogether ill and pestilential in view of their indirect consequences on the health of the city.

Lynn.

Of the thirty thousand people comprising the population of Lynn, the greater portion are provided with occupation, and derive their sustenance from the shoe-manufacturing interest, for which the town is well known. This industry, in connection with the branches of mechanical work allied to it, is

attracting continually a class of thrifty laborers who steadily promote the growth of the population and add to the wealth of the community. The effect of this on the general appearance of the town is manifest, not only in the large and substantial buildings, the manufactories and warehouses, which occupy the streets in the central sections of the city, but in the great number of neat and comfortable, although small dwellings, the homes of the working-class. The impulse of vigorous municipal life is felt also in the suburbs, and scores of dwelling-houses are being built, of neat architectural design and surrounded by a liberal area of ground. These are rapidly taken as homesteads. It is impossible not to draw the inference that there is some intimate relation between this wise policy of separate homes as thus illustrated and the condition of public health which makes Lynn rank high among the cities of Massachusetts in point of salubrity. The plan of congregating many families in tenement-houses finds little favor here, and an impression of prosperity and of healthy development obtrudes itself almost everywhere.

Such is the inference from a general survey of this busy city; but Lynn tolerates within her borders certain "homes" which a detailed inspection can discover and which are very little in harmony with sanitary law and are very discreditable to the health authorities. The instances given below will show how some of the poorest class in this city are provided with house-accommodation.

In a street called South Street, leading from one of the principal thoroughfares of the city and surrounded by residences whose appearance indicated that they were owned and occupied by intelligent and prosperous people, the writer visited a hamlet of three wooden buildings. The largest of these was once a sash and blind factory, and the name of the manufacturer, who is still the owner of the buildings since their change into wretched tenement-houses, appears in bold letters on the side of this main structure. By means of variously contrived partitions, this factory afforded tenements for four families. These families consisted, at the time of the visit, of nineteen negroes, and three whites; the latter, natives of Ireland. The two families on the ground-floor did not suffer for want of light, for the windows of their room were

abundant; but those who occupied the attic beneath the steeply-pitched roof did not fare so well. The approach to these upper tenements was by a broken, dangerous stairway on the outside. The door from these stairs opened upon a narrow passage-way which served as a pantry, kitchen, wash-room and workshed, all in one, and containing a miscellaneous collection of fuel, dirt, food, cooking-utensils and rags, accordingly.

Out of this narrow apartment, a door opened into a larger room, whose ceiling was the sloping roof; the walls were bare and stained with smoke and the tracks of rain; the floor was bare and rough. A small skylight admitted scanty sunshine and shared with the door the privilege of indifferent ventilation to the inmates. The black girl, who was keeping these apartments during the temporary absence of the family, asserted that in rainy weather the roof admitted water in uncomfortable quantity.

Two sleeping-rooms, within this room just mentioned, completed the suite; one was entirely without windows, and got light and air through the door alone; the other had a sash in the roof. Both contained piles of ragged and dirty bedding, thrown promiscuously on the floor, attesting the abject poverty and squalor of the inmates.

The foregoing description is not an unfair detail of the manner in which all the families lived, in the three houses. There were, altogether, thirteen families comprising fifty people. A year ago small-pox found a lodgment here, and took special advantage of the situation to go through the crowded hamlet.

The location of the building was high and dry, and eligible for good drainage; yet an unmistakable stench pervaded the premises. The cause of this pervasive odor was readily found; for these thirteen families, two privies with open vaults were provided, and they were within a dozen yards of the better houses adjacent. The vaults were full and one was overflowing; a stream of night-soil bubbled up from beneath the side of the privy and trickled away toward the house, mingling in its course with sink-drainings which had been thrown on the ground by the tenants. The floors and seats of the privy were foul beyond description.

The air which comes to this elevated spot in a state of comparative freshness and purity goes away burdened with foulness. The wonder is that such a place, with its squalor and its offensiveness, is permitted to continue at all, and especially that it is tolerated in such a neighborhood, where it must be a perpetual nuisance.

Barker Court, another illustration of sanitary improvidence, is at the lowest part of a basin whose deficient drainage compels the stagnation of water almost the year round, and in summer is said to promote the development of an odor which is almost intolerable. There are quite a number of single tenements here, and two or three houses containing several families. The adjacent territory, which is higher and which contains many excellent residences, shares with this depressed area the ill-effects of its low location. The writer was informed by Dr. Pinkham, the city physician of Lynn, that in this region typhoid fever, diarrhœa and dysentery, bronchitis and diphtheria specially manifest themselves. The ground in the street and in the yards was covered with a green fungus mould. The ground beneath all the houses on one side of the court was covered with stagnant water, and the tenants said that these pools had remained in their present condition as to depth throughout the summer

In this court, and immediately adjacent to dwelling-houses, was a stable, with a pig-sty attached in which two large hogs were fattening. A pile of stable-manure embellished the yard. Close to the stable and piggery was the privy, its vault full and open, and its internal appearance extremely foul. These stable premises were the object of grievous complaint among the tenants.

The whole section should be raised and thoroughly drained, and the attendant nuisances should be speedily abated.

The tenement-house called "Buffum's Block" illustrated some of the worst evils of the crowding system. Here was a building eighty feet long, thirty feet wide, and containing a basement, two stories and an attic; the upright rooms were about ten feet in height. At the time of the inspection, nine families, containing forty-six persons, had their homes here. In the basement, below the level of the street, were three families. The inmates of the block were Irish.

A row of sheds in the rear contained the fuel and the privies of the tenants; the privies were very foul, and justified the comment of one of the people, that "no decent woman would go near them." Much complaint was made, also, of a privy on adjoining premises; the vault of this privy was not tight, and as it was on higher ground its contents percolated through the soil and entered the yard of Buffum's Block.

"Perley's Block" on Boston Street, an old wooden shell, with leaking roof, broken chimneys, falling ceiling and general decay, furnished tenements to eight Irish families, containing forty-five persons. The lower story was on one side below the street-level, the grading of the street having covered so much of the block on that side. On the other side of the house was a marsh through which flowed a brook, and this marsh was sometimes under water close up to the doors of the building. Two privies, too dilapidated for use and too filthy to mention, were supposed to fulfil the needs of the tenants.

It was encouraging to observe in this ancient rookery, one poor woman endeavoring to improve her chance for long life, and to give a little cheer and sweetness to her home, by lime-washing the walls and ceilings of her rooms. She was a practical sanitarian.

In one of the basement rooms a woman and her daughter sat by a tub containing green goat-skins. These the two sewed together in pairs, so as to form bags in which the tanning-liquor was held during a part of the process of the manufacture of the skins into morocco. The moist and dirty pelts looked foul, and made the premises and the dress of the women to correspond. For this work they were rewarded with a scanty pittance, which went only a little way toward paying the rent of their miserable abode. In summer, so they remarked, the stench from the skins was "pretty bad" when the warm weather made them "putrid."

Salem.

This city can present, in its house-accommodation for the poorest classes, specimens of the best and of the worst tenement-houses. Of the former, those blocks of dwellings owned and carefully superintended by the corporation of the

Naumkeag Cotton Mills are illustrations. These buildings are constructed with due regard to their use as dwellings, and they are very satisfactory as regards light, roominess and internal arrangement. Their yards, privies and water-service are well attended to, not only by the tenants themselves, but by the company's agents, who are careful to compel general cleanliness. In consequence of the regulations for promoting these systematic measures, an aspect of tidiness and thrift is everywhere apparent about these homes of the operatives.

The situation of these corporation tenements is advantageous, with an abundance of sunlight and of air fresh from the harbor. In some instances, ground that was once unsuitable for building purposes has been reclaimed by filling and by judicious drainage. Ample allowance has been made, in partitioning the tenements, to provide space enough, and to prevent overcrowding among the tenants.

The occupants of these dwellings are, of course, by preference, the families of operatives in the mills, and it is presumed that a certain degree of pride on their part, the legitimate offspring of their improved estate, seconds the efforts of their employers to provide clean, comfortable and roomy homes for them. It is impossible not to note, however, the evidences, even in these carefully superintended tenements, of national characteristics, strongly marked, and, as it would seem, indelible. Some nationalities are, by inherent tendency, careless, improvident and untidy, and it will require generations of training and of promotion in civilization before they can lead, and not follow, in sanitary education. If any comparison can properly be made, the French Canadian residents of the section of Salem above described deserve a word of commendation for their neatness and order.

But one has not to go far from these homes of the operatives in the mills to find homes of a very different sort. Upon the same insulated point of outlying territory on which the Naumkeag Mills and their tenements are built, a region of made land, bounded by Naumkeag Street on the west, and by the harbor on the east and south, are a number of streets containing many scattered tenement-houses. The whole section

is low, and, although the slope of the land is toward the cove of salt water which ebbs and flows with the tide, it is not effectually drained at the surface, and no sewers or deep drains have been laid by the city. In many parts, the ground is submerged under stagnant pools containing all manner of decaying organic matter, and covered with a green scum, the sign of decomposing filth, which, in the warm season, must be intolerably offensive.

It is needless to describe in detail the various dwellings in this district. Scarcely one of them was free from faults in construction or in situation, which would condemn them as nuisances, in greater or in less degree, in the judgment of vigilant health authorities. Plenty of air there certainly was, fresh from the sweeping harbor, but the atmosphere which these people ordinarily inhaled around their homes was surcharged with noxious smells and miasms from the stagnant pools.

To find an illustration of this condition, let the Salem health authorities inspect the house numbered 18 Congress Street. At the time of the writer's visit, this house stood in the midst of a pond of stagnant water. In the same watery lot was an overflowing privy-vault, and a piggery added its contributions to the general filth. Two families, containing altogether sixteen persons, occupied the house, apparently undisturbed by conditions sufficient to poison the air of all the neighborhood.

Other tenements in the vicinity corresponded in character with the one described. At No. 26, in the same street, a single privy was made to serve eight families; its condition may be imagined. The yard was under water, and ashes and rubbish abounded. Goats, ducks and poultry shared the occupancy of the house with the human inmates.

At No. 35 in Congress Street, and along South Prospect Street and East Gardner Street, a similar condition of things called emphatically for radical relief.

The tenement-house on Ward Street, known as the "Old Rubber Factory," has been graphically described in the Report of the Chief of the Bureau of Labor Statistics for 1872. It was found by the writer to be in no degree better than is there reported. Eighteen small tenements, consist-

ing of two and three rooms, poorly lighted and with bare walls, are in this dilapidated wooden barrack, but at the time of the inspection, twelve families, averaging each five persons, were tenants. Most of these tenants were widows. The care of the building and the collection of the rent were delegated to one of the Irishmen, who had long lived on the premises. The building, which is three stories in front and two in the rear, is built into a bank, so that the basement, opening anteriorly on the street, is at the back entirely underground. One of these basements was occupied.

A single well supplied all the families through an old-fashioned wooden pump. This well, being at a low part of the yard, necessarily took the surface-drainage of the adjacent ground, and as the yard was strewn with garbage, refuse and sink-slops, the quality of this superficial water-shed can be conceived. The five privies which accommodated (?) the occupants of the eighteen tenements were in execrable condition; their doors were broken down, and their interior was a mass of filth. The tenants "did not remember" when these vaults had been emptied. A pig-pen was closely adjacent to the privies. Three cesspools, with their connecting-pipes much out of repair, received a part of the sink-slops; the rest was thrown on the ground.

Opposite this factory-building, on an alley running through to Peabody Street, was a tenement-house, which was formerly a barn. It supplied homes to five families. The first floor was a foot below the surface of the ground. In a tenement of two rooms, the larger of which was thirteen feet by eight feet on the floor and seven feet high, a widow and her two children lived, paying rent at the rate of $54 annually. She said it was sometimes very cold there, for the water came in under her floor.

Adjoining this, on Peabody Street, was a tenement-house of a similar character. Eight families lived here, much too closely quartered. The small back-yard was rendered almost intolerable by an open cesspool and a privy in very foul condition.

No walk in Salem can be taken, more suggestive in its associations than that along Derby Street. This thoroughfare along the water-side, at the head of the numerous

wharves, was once the busiest street of all the town. In Salem's prosperous mercantile days, this long avenue was crowded with all the evidences of successful traffic. On one side, large warehouses received the stores from beyond the seas as they were landed from the great ships; while, on the other, the Salem merchants lived in the enjoyment of their accumulated wealth.

But the days of the rich India trade have passed for Salem; commercial enterprise has yielded to other interests, and the wharves and warehouses are no longer the scene of vigorous mercantile life. The mansions have surrendered their rich and aristocratic inmates; with the retirement of the commercial enterprise, a new class has taken possession. What was formerly the richest quarter is now almost the poorest and most depraved. The great houses are partitioned to make tenements. Even the wharves, now no longer serviceable for the moorage of ships, are delivered over to become the homes for scores of laborers' families. In this once proud thoroughfare, poverty seeks its dwelling-place, and vice, dirt and ignorance, its attendants, prevail.

The majority of the dwellings in this strangely changed quarter are better than the class of people who occupy them usually select. The old mansions are so situated that overcrowding of the land-area with houses is impossible, so long as these substantial structures shall stand. The interiors of the dwellings are, however, in many cases so changed for adaptation to the demands of the present tenantry, that the allowance of room is at the minimum.

The worst house found during the inspection of this section was that numbered 22 on Tucker's wharf. It was filthy within and without. A pig-sty was at the door. The slops were thrown on the ground about the door, and all sorts of refuse littered the yard. In a single room under the roof, scarcely big enough to contain the two dingy beds, and lighted and ventilated by a small square sash at either end, the six inmates of the family slept in promiscuous informality.

On this wharf, at No. 15, two families occupied cellar-tenements, each having two rooms.

At No. 9, a dirty back-yard, overflowing privy-vault, and redolent pig-sty, gave evidence of inexcusable neglect.

At Gerrish Place was found an emphatic illustration of neglect on the part of the landlord. A two-story wooden tenement-house, intended for twelve families, but occupied at the time of the visit by eight, was shamefully out of repair. Its windows were broken, its roof leaked, its cellar was dirty and wet, its privies (two for the house) were full and filthy, its cesspools were filled with ashes or overflowing with dirty water, its yard was neglected, and the whole aspect of the premises was that of decay and misery.

Moreover, there was the most reckless improvidence on the part of the owner or owners; none of the tenants ever saw the landlord or his agent, or knew who he was. At long intervals somebody came, when things became especially bad and the premises were complained of as a nuisance, but any manifestation of interest in the welfare of the tenants was almost wholly wanting; it appeared to be of little consequence to the proprietor whether these people paid their rent regularly or not at all, whether their comfort and health were at hazard because of the need of repairs, whether, even, old tenants moved away and new ones moved in without notice. Families have been known to occupy rooms for quite an extended term without the knowledge of the owner or of his agent, and, accordingly, rent free. At the time of the visit of the writer the premises were an unequivocal nuisance.

Springfield.

The poorest class in the people of Springfield, comprising the families of railroad laborers and the like, do not constitute a numerous company, and their habitations are relatively few. In comparison with many cities of larger size, the number of families in which squalor, misery, filth and such accompaniments of poverty abound, is quite limited. These people live in isolated and well-defined sections,—in portions of the city where the homes of the better class are not found. Miserable enough some of these dwellings were seen to be, exemplifying the worst sanitary evils which can pertain to human habitations.

The greatest number of these abodes were found on a narrow belt of land along the crest of the river's bank, at the lower part of the city. This strip of territory is separated

from the rest of the city by the tracks of the New Haven Railroad, and is scarcely broad enough for the single series of tenement-houses, which are close to the edge of the steep bank of the river.

The worst of these buildings is that known as "Trask's Block," a brick structure designed for twenty-four tenements, of three rooms each. The rear of the building is close on the line of the railroad, and the front faces on the river's bank. On the steep slope in front was a plentiful display of all the garbage and refuse which the families had accumulated there since the last rise of the river had washed away the previous gathering of a similar nature. The house was greatly out of repair,—its windows broken, its stairs dangerous, its roof leaking. The privy arrangements were peculiar. At each end of the porch or piazza on which the front doors opened was a rough out-building. The two out-houses were designed to accommodate all the tenants, a design plainly evident to any one approaching the house. The vaults were brick receptacles, entirely above ground, the steepness of the slope beneath the porch giving room for this method of building. One of the vaults had broken outward and the abundant contents had settled away, a filthy mass of excrement gradually approaching the river's edge. Most of the tenants declined the use of these privies for obvious reasons, and resorted to expedients which can only be hinted at.

For water, these people were obliged to go to a spring at some distance from the house, the well originally provided being no longer available. When, however, the river rose above the level of the spring, a not infrequent occurrence, they took the water needed for cooking and drinking from the river itself, not far from the point at which one of the main sewers emptied into the stream. During the writer's visit to the premises, one of the tenants, a barefooted, uncomely Irish woman, took from her room a pail filled with chamber-filth, and having emptied it into the river near the spring, she rinsed the pail and filled it with water for her domestic use.

The condition of things above described fully justified the complaints and execrations of some of the tenants, who

represented that the filth and stench were almost intolerable during the summer months.

The adjoining premises, familiarly known as "Hole-in-the-Wall," were a trifle better as a human habitation, but by no means tolerable. The owner relies on the uncertain service of the stream below to wash away the accumulated night-soil from the privy-vaults, whenever a flood makes the depth sufficient; and to this end, the wall of the vault toward the river was left open.

The building called "Smith's Block" helps to maintain the bad reputation of the neighborhood with respect to nuisances. The yard was covered with swill, garbage and filth; while the privy conveniences were still more elementary and less tolerable than those before alluded to, consisting of the ordinary filthy, dilapidated out-houses over a perfectly open inclined plane of plank, freely exposed to view from the river. When the water rises, this planking is temporarily cleaned; at other times, surface-drainage, promoted by rain-falls, carries downward much of the loose excrement to the stream, where it mingles with the water, habitually used for washing the clothes of the people who live in the more aristocratic quarters.

Another of these river-bank houses was called the "Bee-Hive." It contained nine tenements, crowded like the neighboring houses, with Irish tenants. It had once been used as a store-house. Its basement was let to a family at the rate of eleven dollars a month. The yard was filthy with sink-drainage, swill and the like.

One noteworthy feature with regard to these tenement-houses was the manner and place of the discharge of one of the main sewers of the city into the river. The mouth of this sewer was immediately adjacent to this settlement, close down to the water's edge, indeed, but at most seasons of the year perfectly exposed. The arrangement for the discharge of the sewage was not apparent, whether a trap existed or not; but the writer was informed that a simple swinging door was the only apparatus at the mouth of the pipe. Those resident near by asserted that, in the hot season, the stench in that vicinity was very bad.

In Union and Wilcox Streets, at their lower extremities,

and so near the section just described as to be really a part of it, a number of insalubrious places occupied by poor Irish laborers were visited. "Haley's Block," at No. 35 Union Street, was one of these. The yard in the rear was excessively dirty and the open mouth of the well received plenty of surface-drainage to pollute its water. The basement of this house furnished a home to its owner; in two rooms, more than half underground, he and his wife and their six children had their abode. The front room was twelve feet square and seven feet high and the bedroom was twelve feet by eight. In the bedroom was a single window, two feet by four, to all appearance never opened. The rooms were both miserably filthy.

At No. 20 in the same street was a tenement-building for eight families. They had each two rooms A cow-stable with its pile of manure and a full privy-vault were in close proximity.

The section to the east of Main Street, comprising the western extremities of Liberty, Ferry, Sharon and Congress Streets, is filled with houses for the poorest class. It is a basin whose level is ten or twelve feet below the level of Main Street. Prudent foresight on the part of the city authorities would dictate the filling of this territory. As it is at present, it is inevitably deleterious in its influence on the health of those living there. At the time of the visit there was much stagnant water upon the surface, and in the absence of any proper drainage the whole section must be damp the year round.

The character of the people and of the homes in this section coincide with the ground on which they are; they are below the proper level. A large number of basement-tenements were observed. The yards were foul, the privy-vaults were neglected, and numerous stables added the unsavory contribution of their manure-heaps to the general dirt.

As regards the relative amount of sickness in the localities which have been described as compared with the up-town sections, the writer was assured by two physicians of excellent authority that disease was of greater frequency among these people, that two-thirds of the cholera infantum occurred in these tenement-houses, and that while the general average of

mortality from consumption in the city was less than formerly, in these districts it was greater.

Worcester.

The tenement-houses of this city are asserted, on competent authority, to be in better condition and more habitable than they have been in former years. It is said that partly in consequence of more zealous attention to their sanitary state on the part of the board of health, and partly, also, because of an improvement in the social condition of the laboring-classes, the house-accommodation of those classes is comparatively less objectionable on sanitary grounds. There is no doubt that the medical profession in Worcester appreciate the importance of proper sanitary administration as influencing the health of the whole people. The office of city physician has repeatedly been filled by men whose vigor and efficiency have had a marked effect in municipal health affairs.

While happy to make this favorable reservation with respect to the municipal supervision of the tenement-houses, the writer feels bound to report great room for farther improvement. The sanitary condition of the poor is still far from being as good as it might be, and there is a lack of many elements which might be applied to remove preventable sources of physical and moral deterioration in and around the dwellings of the poor. A walk through the quarters of these people reveals a sufficiently large field for hygienic zeal, as the following notes may indicate.

Between Mechanic Street and Front Street is a section, lying very near the Albany Railroad station, which is low and flat. The centre of the region is Spring Street; on either side of this narrow thoroughfare and in adjacent courts are a number of dwellings occupied by Irish. They are not especially uninviting in their external aspect, but a closer inspection of the premises discovers many nuisances. Immediately adjoining one tenement a trio of hogs fattened on the collection of swill and garbage of the neighborhood. Under another house was an extensive and quite deep puddle of water, the overflow of a broken aqueduct-faucet which, at one corner of the house, supplied all the families in the building. At No. 5 in the court leading from this street was an old house, in the

basement of which, two women, a widow and her aged mother, lived; the former paid the rent and other expenses of the pair by stitching shoes by hand. The entrance to the tenement was down a flight of broken wooden steps. The women said it was cold and uncomfortable, but they could not afford better things. Two rooms, both half underground, and dreary enough with their smoky ceilings, bare walls and small windows, were all the home these women had.

The yards of these buildings in Spring Street were dirty and offensive, with a plentiful litter of refuse, ashes and swill.

Another group of Irish tenements not far distant from the last, rivalled them in all bad qualities. They were on Mechanic Street, and were known as "Coffee's Buildings." The yards were exceedingly filthy; in addition to a plentiful dressing of garbage, the sinks contributed a fluid nuisance, discharging all their drainings directly on the ground from lead-pipes which protruded through the side of the building. The single privy which was for all the tenants was open and excessively filthy and offensive. Adjacent were other privies, entirely open, with seats and floor too foul to describe. Near at hand a piggery contained tenants congenial with the surroundings, but incompatible with the city ordinance.

The occupants of these wooden barracks were of the lowest laboring-class. Some of them were especially degraded in appearance and manner and scarcely understood English. One large family occupied a cellar tenement.

Perhaps the most emphatic illustration which Worcester could furnish of a bad tenement-house was found in a block of wooden houses on Shrewsbury Street. It was known as "Pond's Block." It was intended for nine families, not including a series of basements which were sometimes hired for liquor-saloons; only four families, however, found the place sufficiently attractive, at the time of the writer's visit, to pay the exorbitant rent demanded for such dwellings. Externally the house appeared deserted, if window-casings without sashes, and sashes without glass, and broken and unhung blinds, and general decay were significant. Yet the place was a home to human beings. In one tenement of four rooms were found an Irish family of eleven persons, a father and mother and nine children. The father pointed out some of

the pleasant features of his residence. There was no latch to the door, and at night he secured his rooms and obtained some degree of privacy by piling his furniture against the entrance. Scarcely a whole pane of glass kept the frosty air from the inmates. The man had rented with his tenement the basement beneath him, but he had, in great disgust, determined not to occupy this cellar as a bar-room, because of its filth. The floor of the cellar just behind the bar-room was a mass of reeking mud, and the sink-drain, which was suspended along the sleepers overhead, was broken and leaking. For these apartments the man was charged $22.50 a month.

In one of the basements of this block a family lived who had had their home in various parts of the building during the last four years. It consisted of two adults and a child. They had three small rooms, one of the two rooms in the rear being a bedroom and the other for storage. The former had no window. The sink was obstructed and the slops were thrown in front of the door. Sometimes the water came into the sleeping-room through the rear wall. For this tenement the rent was $10 a month.

Throughout the house there was dirt. No attempt was made to keep the vacant tenements secure by lock or bolt; the doors even were in many cases wanting. The water-pipes were out of repair and the sink-drains were full. The floors of several of the rooms had been used as privies by occupants of the house and by chance passers. The shanties originally intended for privies were too filthy to be entered and their vaults were overflowing.

Adjoining this building, was another tenement-house for six families, owned by the same man as the last. In most respects it rivalled its neighbor in filthiness. The privy of the house was within eight feet of the back-door, and its vault was full and uncovered. The yard was foul with swill. The tenants stated that the landlord was very regular in his demand for the rent, but scarcely ever heeded their complaints for repairs.

The section called "Pine Meadow" is the Five Points of Worcester. It is at the eastern part of the city, and consists of a hamlet of tenement-buildings, comprising, generally, old houses which have been removed here and altered, not to

become habitable dwellings, but to give the largest available rent. The houses are crowded, and the police know the region as the worst under their supervision. Drunkenness and crime make repeated calls on their services. Piggeries add to the general filth. A number of basements were found occupied as tenements by people two poor or too degraded to seek for better quarters. In some instances the most disgusting condition was found without and within the houses. In other instances scarcely any proper provision was made for the healthful comfort of the tenants. At No. 57 East Worcester Street, a cellar-tenement of three rooms, two-thirds underground, was let for $6 a month to a widow, who lived there with her three children. The mother supported herself and her family by the sale of beer. In this tenement there was no wet-sink, and the slops were thrown on the ground near the door. No water-service was supplied in the house, and the people were obliged to go to a distant well for water for their cooking and drinking purposes.

In the vicinity of "Pine Meadow" is a cemetery, and the moral character of the inhabitants of this section could be inferred from the repeated desecrations which the burying-ground had suffered,—its tombs broken open and its memorial-stones thrown down.

In the southern part of the city, is a section known by the euphonious title of "Scalping Town." Here one large tenement-house was seen situated on the very edge of an undrained marsh. It contained ten dwellings, each of four rooms. Two cellar-tenements were occupied. The storage-cellars were on the ground-floor in the rear of the basement-dwellings, and they were always wet and frequently flooded. It was not unusual to these tenants to see their front-yard under water and their fuel submerged. The worst feature of this building was its location; and it will continue to be objectionable until the marsh is systematically drained.

In the vicinity of this place were found other dwellings open to sanitary criticism. Such were tenements in Winter street Place, and in Salem Street, adjacent to the city stables; where the situation is too low for drainage into the common sewer, and the sink-slops flow on to the ground to make a stagnant, filthy pool near by.

Such are some of the facts pertaining to the house-accommodation of the poor, as they have been gathered in the course of a personal inspection in the large cities of Massachusetts. They are believed to possess a value as a contribution to the beneficent work whose aim is to elevate the sanitary and the social condition of the self-supporting poor, and so to promote the welfare of the whole people. They are a salutary exposure of some of the evils incident to the commonly prevailing improvident and unsanitary system of house-accommodation. They represent an amount of human misery and degradation not easily conceived. They suggest physical and moral decline, whose special characters no pen can adequately delineate. They recall fearful lessons which the past has failed to profit by, and they indicate no less fearful probabilities in the future, associated with the conditions in which the overcrowded, neglected, ignorant poor are permitted to continue. It is hoped that they will aid in confirming what has already been accomplished, in wisely amending the sanitary abuses which pertain to the dwellings of the working-classes in the large cities, and will stimulate to greater energy the work of hygienic reform.

That such conditions as have been described must exert a deleterious influence on the health of those subject to them would seem to be too obvious to require any discussion or formal demonstration. The whole weight of common sense and the whole sum of the experience of the past are in favor of the conclusion, that where filth, overcrowding, inattention to ventilation, bad drainage, the exclusion of sunlight most abound, there disease and death gather their victims most conspicuously. It is not meant by this, that these unsanitary conditions can originate disease, or can directly kill, but, by the slow deterioration of vitality which they favor, they are the strong ally, the active coefficient of human disorder and decay, compromising the power of endurance in those who are continually exposed to them, and too often opposing an effectual obstacle to restoration.*

* To fully demonstrate the relation between excessive disease, or mortality and excessive overcrowding and its attendant abuses, would require an aggregation of facts and figures, comprising a series of years and many places. For the present, with the existing methods of registration of mortality, and without any system for the

There will be many who, acknowledging the truth of all that may be asserted concerning the evils of the tenement-house system, will yet affect indifference with regard to possible reform in the matter. They will say that the endeavor to lift the ignorant and degraded class out of a condition to which they are so assimilated, and which they may be said to love, is too Utopian to be practically philanthropic. These specious opponents of any sanitary reform in this direction should be reminded that in no slight degree is the health of a whole city, the best social sections with the poorest, compromised and jeopardized in proportion to the degree to which conditions which appear to be irreparable and unpreventable are permitted to become developed. The rich suffer with the poor, because every crowded tenement-house, every neglected yard, cellar and privy contributes something to the general contamination, and the health of a whole neighborhood feels the deleterious effect of an ill-ordered alley or court filled to repletion with unwholesome inhabitants. For the sake of the physical integrity of the whole community there should be no indifference, and measures and methods for the correction of the evils in any city should command the coöperation and sympathy of all classes.

It is difficult, in commenting on the bad effect exerted on the public health by the habitations of the poor as at present generally ordered, to keep out of sight the close alliance which exists between physical want and misery and moral degradation. It is an association which constantly forces itself on the attention of any one at all conversant with these classes. Not only do almshouses and hospitals recruit their inmates from the quarters where the poor are huddled in unsanitary promiscuousness, but the jail also recognizes the well-defined districts whence its habitual convicts are taken. The moral as well as the physical condition of a population

registration of disease, absolute statistical testimony concerning this relation is necessarily out of reach. An important indication of the conclusions toward which such investigations would tend is afforded in the report of this Board for 1871, page 350, wherein is presented an analysis of the mortality of the city of Boston for 1870, based on sectional differences as regards conditions believed to influence the duration of life. The contrast there shown between the ratio of mortality in the better parts of the city, where good homes and favorable surroundings are the lot of intelligent inhabitants, and that in the worst sections, those most crowded, most filthy and most insalubrious, is suggestive, if not startling.

becomes inevitably assimilated to that of their habitations. Physical uncleanness and moral pollution are correlative, and it is impossible that persons accustomed by necessity or choice to live in a filthy community, to share promiscuously the domestic arrangements which decency is accustomed to surround with privacy, should not become demoralized. The very conditions which lower the tone, blunt the nerves and vitiate the energies physically, also exert a corresponding moral effect. The intelligent student of sanitary science cannot ignore, if he would, this element in the problem, and only feels the greater demand for better things.

In the presence of such conditions as we have thus touched upon, the problem of vital importance is concerning the remedy for their present amendment, and for the prevention of their recurrence in the future. Can old tenement-houses be made better than they are, and is there enough active interference in the way of sanitary supervision of the plans ot those proposed in future? What is the prospect of amelioration?

And, first, Can much be expected from the tenants who occupy the houses? Granting all the deficiencies which belong to the house-accommodation of the poor, is there in these, the lowest classes, a manifestation of the inherent tendency of mankind to rise to better social and moral conditions, sufficient to warrant the belief that the spontaneous energies and ambition of these people will sometime create a demand for more habitable homes, and lead to the abandonment of such dwellings as are now too frequently provided? The foundation for such a faith is a narrow one, and is distantly prospective. These people are poor, and dependent for support on the unskilled labor of their hands. Their poverty and their dependence compel them to accept the condition of things that is offered them. They are not masters of their circumstances, and if, by exceptional energy, any of them grow out of their degeneracy and attain better fortune, their vacant places in the tenement-houses are quickly filled by those reduced through misfortune, while the emigrant-ships supply any deficit in the ranks of poverty, ignorance and degradation by recruits from the slums and huts of the Old World.

Poverty, forced to take up its abode in miserable habitations, quickly begets a loss of pride and self-respect, or confirms their hereditary absence in those who have never known them. It is probable that many of the tenants in the lowest courts and alleys do not secure as good homes for themselves as they might. It is lamentably notorious, indeed, in very many cases, that they prefer their present degradation to any change for the better, careless a ike of the benefits to themselves and to their children from improved house-accommodation, and ignorant of the subtle influence of their present insalubrious surroundings to demoralize and destroy. Those who administer public charities,—the hospitals, the dispensaries, the aid-associations,—know well the character which is here represented, the abject loss of self-esteem and of self-dependence, which is indigenous in courts and narrow alleys. The reports of these institutions, defining the residence and the nationality of the ready recipients of charitable service, are very suggestive.

A distinguished English sanitarian * has lately asserted that "the cardinal basis of national health is a wise education." The aphorism is a true one; but if it be applied to the classes most in need of that education, it is too theoretical, for the process of their spontaneous emancipation from present subjection to unhealthful surroundings must be slow and uncertain. It is not well to trust too hopefully to such an agency as education to effect the sanitary regeneration of the poor. With the burden of habit heavily upon them, with so little intelligent ambition, with such hereditary contentment in insalubrious homes, external, peremptory and immediate forces must be brought to bear upon these classes to bring about their hygienic renovation.

If so little can be expected from the unaided efforts of the tenants toward attaining better homes, certainly not much can be hoped from the landlords, as a class. Shameful as it is that prosperous and reputable men can consent to hold the relation which many do toward their tenants, for the sake of selfish aggrandizement, there is very little encouragement that their selfishness will become revolutionized, so long as rentals

* Dr. Henry Acland.

show such cheering returns for capital invested. If Christian gentlemen in high station can reconcile it with their notions of uprightness, and with their conscientious convictions of honor, to own tenement-buildings like those described, whose construction and surroundings render them wholly unfit for human habitations,—dark, filthy, dilapidated rookeries, from which exorbitant and wholly disproportionate returns are received, is there not some pretence of excuse, or extenuation for the less favored landlord, whose training in business honor and in morality has been in less cultivated schools, if he make haste to be rich by emulating his superiors in taking advantage of the necessities of the poor? It is a mean and unworthy subterfuge which, in either case, shifts responsibility on wholly irresponsible agents, or on middle-men, who are willing, for the commission, to extort each month the hard-earned rent-money. The twenty-five per cent. of profit accrues to the landlord, and with such comfortable rates of interest, there is little chance that he will incline to help humanity by the practical application of any sanitary sentiment to the welfare or comfort of his tenantry.

Some most worthy exceptions must, however, be made in thus representing the character and relation of the tenement-house landlord. The owners of the dwellings of the poor are not all extortionate or improvident of their tenants' sanitary welfare. Many instances might be cited in which landlords see it to be their duty, as well as their interest, to make their tenants comfortable and to insist on cleanliness and decency.

But perhaps the most gratifying results have come from the alliance of capital with philanthropic purpose. Whether the experiment has been made by individual capitalists or through incorporated association, the fruits of the endeavor have been highly satisfactory. What has been done in this direction in England is well known. The beneficent schemes of Peabody and of Miss Burdett Coutts, and the operations of the Improved Industrial Dwellings Company in London, have demonstrated what may be accomplished in this direction.*

But we need not go far from home to discover an emphatic

* See the Second Report of the Massachusetts State Board of Health, pp. 193–218.

illustration of the good effects of an intelligent and philanthropic purpose to ameliorate the sanitary condition of the poor, by making their bad homes better and by providing new homes of the best. The structure in Lincoln Street, Boston, known till recently as the "Crystal Palace," and notorious in past years as the vilest example of a low tenement-house, has been regenerated through the systematic efforts of the Boston Coöperative Building Company, an association not yet three years old. So radical has been the change in this once infamous establishment, that the writer makes no apology for quoting the following account from the Report of the State Board of Health for 1872 :*—

"The most interesting and important act the corporation has performed was the hiring of the Crystal Palace. It was described, in last year's report, as the abode of filth, robbery, drunkenness and prostitution. * * * * Under the rule of the company the following most interesting results have been obtained: The building outside, instead of being a disgrace to the street by its filthy look, has a neat appearance. It has changed its name and now instead of the name of contempt, 'Crystal Palace,' it is styled the Lincoln Building.

"Before the corporation entered, riot, disorder and arrests for drunkenness and family broils, were of constant occurrence. The place was the objective towards which apparently all the scoundrels of the neighborhood congregated. * * * * All is now changed. The trade of the police is virtually gone. The chief of the district reports that during two months he heard of no complaints there. The grog-shop that had existed from the time of the erection of the building was swiftly swept away. A 'Holly-Tree Coffee House' has taken its place. The basement-tenements * * * were shut up immediately after the company took possession. Very large shafts have been cut through the roof of the building, through all the floors, with ventilators above them, and rooms that have never had light and air now have a sufficiency of both."

Such results as these show what is possible in sanitary reform, and the lesson is the more emphatic in view of the unpropitious subject of the experiment. The work of such an association is worthy of all emulation in radically amending what is unwholesome in the present habitations and in erecting new dwellings which shall serve as models. The writer is glad to report that the present condition of Lincoln Building, as observed on personal inspection, is a continued evidence of the philanthropy and wisdom of the reform un-

* Page 11.

dertaken by this company. Every city of considerable size, in this State and in every State, can provide ample opportunity for the beneficent operations of just such associated effort.

In this connection a word should be said concerning the scheme, advocated so cordially by Mr. Quincy and others, in favor of suburban homes for the working-classes, built and occupied on the coöperative plan, and, by means of cheap railroad transportation, before and after working-hours, made available to the laborer whose work is in the city. The proposition is, in theory, an eminently wise one, for it aims to enable the poor man to become his own landlord, to remove his family from an insalubrious city tenement to a country home; it purposes to relieve overcrowding and its attendant evils by substituting a condition far preferable. It offers a fair profit to the investment of the capitalist and at the same time gives the laborer a chance to become more self-reliant and more independent, as well as more healthy.

Already signs are manifested that the plan will ultimately find favor with the classes it is designed to help. As a practical method for the relief of the problems which have been discussed, it deserves the highest success.

One of the chief obstacles, however, to the present realization of such a scheme is the disinclination of the laborer,—of the very poor and unintelligent class,—to accept such an opportunity when it is offered. The principal causes which operate to fill and to keep full the city tenement-houses are their cheap rates of rent and their proximity to the work which falls to their occupants. The laboring-man of low degree, belonging to the class most needing emancipation from the detrimental influences of the tenement-house, will prefer to keep his inferior and unhealthy city quarters, which are small, cheap and near his work, rather than accept another chance with superior probabilities, on sanitary or social grounds. The average laborer must grow up tediously to an appreciation of what is possible to him in his home. For the present, he waives considerations of neatness, of convenience, or of comparative comfort, and takes the cellar or the attic, esteeming the immediate necessity as of greater consequence than any prospective advantage.

Indirectly the coöperative plan will do these classes great good by vacating tenements now occupied by mechanics whose intelligence enables them to see the advantages of such a project, and who are not dependent on casual employment. A promotion in house-accommodation is thus opened to the class below them.

But the conditions to which the poorer classes are exposed in their habitations urgently need immediate amelioration. It is unwise to await the slow civilization of the degraded poor, or to expect much better things of landlords, or to depend on the results of limited philanthropic enterprise. The remedy should be prompt and, as far as may be, efficient. It lies chiefly in the power of the law and in its honest administration.

And surely the law-givers of Massachusetts have not been unmindful of their responsibility in this direction. Chapter 26 of the General Statutes shows that early in the history of the State the legislators appreciated the importance of broad and comprehensive measures for the protection of the public health throughout the Commonwealth. Some of the provisions of this Act are as follows :—

SECTION 1. A town respecting which no provision is made by special law for choosing a board of health may, at its annual meeting, or at a meeting legally warned for the purpose, choose a board of health, to consist of not less than three nor more than nine persons; or may choose a health officer. If no board or officer is chosen, the selectmen shall be the board of health.

SECT. 2. Except when different provision is made by law, the city council of a city may appoint a board of health; may constitute either branch of such council, or a joint or separate committee of their body, a board of health either for general or special purposes, and may prescribe the manner in which the powers and duties of the board shall be exercised and carried into effect. In default of the appointment of a board with full powers, the city council shall have the powers and perform the duties prescribed to boards of health in towns.

* * * * * * *

SECT. 8. The board or health officer shall order the owner or occupant, at his own expense, to remove any nuisance, source of filth, or cause of sickness, found on private property, within twenty-four hours, or such other time as it deems reasonable after notice served as provided in the following section; and if the owner or occupant neglects so to do, he shall forfeit a sum not exceeding twenty dollars for every day during which he knowingly permits such nuisance or cause of sickness to remain after the time prescribed for the removal thereof.

* * * * * * *

SECT. 10. If the owner or occupant fails to comply with such order, the board may cause the nuisance, source of filth, or cause of sickness to be removed, and all expenses incurred thereby shall be paid by the owner, occupant or other person who caused or permitted the same, if he has had actual notice from the board of health of the existence thereof.

SECT. 11. The board, when satisfied upon due examination, that any cellar, room, tenement or building, in its town, occupied as a dwelling-place, has become by reason of the number of occupants, or want of cleanliness or other cause, unfit for such purpose and a cause of nuisance or sickness to the occupants or the public, may issue a notice in writing to such occupants or any of them, requiring the premises to be put into a proper condition as to cleanliness, or if they see fit, requiring the occupants to remove or quit the premises within such time as the board may deem reasonable. If the persons so notified or any of them neglect or refuse to comply with the terms of the notice, the board may cause the premises to be properly cleansed at the expense of the owners or may remove the occupants forcibly and close up the premises, and the same shall not be again occupied as a dwelling-place without permission in writing of the board.

Section 14 provides for the forcible entry of premises by the board of health, for the purpose of inspection, and grants the aid of sheriffs and other officers of the law in the execution of this power.

Such are some of the provisions of the general statute law which are available in the management of tenement-houses and which are of general application. Other supplementary enactments define certa n features of this law more specifically.

Thus, Chapter 211 of the Acts of 1866 provides for appeal to the county commissioners in case the board of health in any city or town refuse or neglect to pass proper orders abating a nuisance or nuisances and these commissioners may have, in such case, all the powers of a board of health as designated in Chapter 26 of the General Statutes, above quoted.

Chapter 271, of the same year, provides that boards of health may appoint an agent or agents to act for them in cases of emergency; and the agent so appointed may exercise all the authority which the board appointing him had.

Chapter 160 of the Acts of 1868 extends the provisions of Chapter 26 of the General Statutes and enacts that "when any lands in any city or town are wet, spongy or rotten, or covered with stagnant water so as to be offensive to persons residing in the vicinity thereof, or injurious to health, the same shall be deemed a nuisance," to be abated by the board of health of the city or town containing it; and provides the

methods of proceeding, in the matter of giving hearings to parties aggrieved; of making such improvements in drainage and the like as shall be required to correct the nuisance; and of awarding the damages incurred.

But the law for "the preservation of the public health," which, in its general application was deemed comprehensive enough for the State at large, was not thought enough for Boston, a city of large population and of metropolitan character; so that in 1868, the general court enacted Chapter 281, the Tenement-House Act, whose sections provided a great number of specific regulations, defining and limiting the functions of the board of health concerning tenement and lodging houses upon an elaborate and diffuse scheme. This law was founded on one which appeared to have been found practicable and useful in New York, where an expert and disciplined corps of sanitary inspectors, composed of medical men, aided most essentially in securing the advantages and fruits belonging to sanitary legislation in the metropolis.

In 1871, the Tenement-House Act was repealed because it had not accomplished much, or for some other reason not quite clear; and in its stead, a law was made which, in sixty-three sections, covered all that the previous Act comprised and a great deal more beside, providing for "the regulation and inspection of buildings, the more effectual prevention of fire, and the better protection of life and property in the city of Boston." This law is numbered Chapter 280 of the Acts of 1871, and is known as the Building Law. Among its numerous sections, are included seventeen [34–50] which are devoted to the regulation of tenement-houses. These seventeen regulations, prohibitory and restrictive, are elaborately technical, but, if properly understood and honestly enforced, they might afford great relief in matters to which they refer. Their complication, however, with other things makes them involved and unsatisfactory; and the collision of authority resulting from the investment of the execution of the building law in two coördinate departments of the city government,—namely, the board of health and the department for the inspection of buildings,—greatly compromises any benefits which were intended. It is very difficult to determine just where the functions of one board begin and those

of the other end. Many matters which, according to Chapter 26 of the General Laws, are left to the discretion and in the control of sanitary boards, are here transferred to another and a new official, who by the latest enactment is deemed essential in Boston to supplement an unpractical board of health.

If, however, the inspector of buildings in Boston and the board of health find it possible to act harmoniously in the enforcement of this law, it is scarcely to be doubted that they will together find any lack of statute provisions in this complex instrument. Lest the plain and comprehensive instruction of section 11, chapter 26 should, from its general terms, induce some administrative indifference,* the authorities of Boston are favored with enactments for the care of its tenement-houses as follows:—

1. The construction and appurtenances of tenement-houses in Boston shall, "on the requisition of the board of health," conform to this Act, and the inspector of buildings shall see that the Act is carried out in accordance with such requisition, and shall approve all plans for new houses.

2. Exterior walls shall be of brick or stone.

3. Tenement-houses shall have their sleeping-rooms properly ventilated by transom windows, and their halls shall be ventilated by means of a proper ventilator in the roof.

4. A suitable fire-escape shall be provided.

5. Roofs to be kept water-tight, and the stairs and their railings safe.

6. The water-closets and privies shall be approved by the inspector of buildings; they may be used in common by the occupants of two or more houses, in the proportion of one to every twenty people; they shall connect with sewers where practicable, and in a manner acceptable to the building inspector. Avoidable cesspools are prohibited and back-yards must be drained.

7. Cellar-tenements may be occupied as dwellings with the permission of the board of health, and without such permission, provided certain conditions as regards height, underground proportions, drainage, ventilation, &c., are fulfilled.

8. Cellar sleeping-rooms must have the approval of the board of health or of the superintendent of health.

9. The removal of garbage and refuse matters must be provided for; and the keeping of detrimental articles and of animals is prohibited.

10. The owner or keeper of the house is held responsible for its cleanliness in all its parts, in a manner and to a degree satisfactory to the board of health. The name of the owner or agent must be legibly posted within the building.

11. Free access for inspection is given; and the presence of infectious and contagious diseases must be reported by the owner or keeper to the board of health who shall take action accordingly.

* See page 435, *ante*.

12. Houses unfit for habitation, through the presence of infectious disease or for the want of repair, may be closed by order of the board of health, and kept vacated at their discretion.

The remaining five sections refer to prospective buildings and regulate the ground area, the height of rooms, the number and size of windows, the means of ventilation for rooms and hall-ways, the construction of chimneys and the water-service. Finally, "the inspector of buildings, with the approval of the board of health, shall have authority to make other regulations as to cellars and as to ventilation, consistent with the foregoing, when he shall be satisfied that such regulations will secure equally well the health of the occupants"; the building inspector, in other words, being executive, and the board of health advisory in the important matters of ventilation and of cellar-dwellings.

The obvious objections to this last clause were appreciated by the legislature of 1872, who amended it by giving the authority to the board of health alone to "make other regulations as to cellars and the ventilation of tenement-houses."

One is certainly at a loss to discover the special need which Boston has for such an amount of legal verbiage and complex statute limitation to enable it to take proper sanitary care of the homes of its poor. It is difficult to understand why the general law for the preservation of the public health * is not broad enough and comprehensive enough to enable any discriminating and efficient board of health to do all that can possibly be attained by the provisions of such legislation as chapter 280, Acts of 1871. Surely the tenement-houses of Boston are not so much worse than those of Fall River or Salem or Springfield that a special law is needed here, nor is the preservation of the public health so much more important in Boston than elsewhere. If the board of health of Boston needs such a multiplicity of technical instructions, together with the equivocal support of a coördinate department to enable it to go right, surely the same need exists in other populous localities; while, on the other hand, if the general statute avails for conditions outside the limit of the capital, it ought to serve here. This general statute gives to boards of health

* Chapter 26, General Statutes.

the responsible position of active official guardians of the public health, their more or less expert discretion is made the safeguard of the community against the preventable sources of disease, including those which have been detailed in this Report. To them are granted extraordinary, in some senses arbitrary legal powers for the administration of their office. They scarcely need the additional aid or control of such enactments as the Boston Building Law. They certainly do not need the embarrassment of such a section as that which leaves the occupancy of cellar-dwellings provisional, when, by all sanitary and medical experience, such occupancy ought to be absolutely prohibited by law.

This glance into the statute-book of Massachusetts can hardly leave a suspicion that there is any lack of law for the sanitary regulation of the homes of the poor. It is, however, scarcely possible to judge correctly of the practical merits or demerits of these laws as they now stand, or to estimate the actual disadvantage attending their execution. It is deplorable that enactments capable of great good to the health of the whole people, if honestly executed, are, for want of honest execution, nearly dead letters in practice in almost all the large cities of Massachusetts. In a general way, they may be said to be in force as directing and developing municipal easures and ordinances for the preservation of outside cleanliness and decency, but a cordial, energetic adoption of them by any city can scarcely be asserted.

The cause of this indifference lies in part in the constitution of the boards of health in the various cities. Uniformly, health affairs are delegated in these cities to the mayor and aldermen,* an unwieldy body of politicians, elected annually, with no distinctive responsibility and with no intelligent experience in sanitary administration. In one or two instances cities have appointed a special health officer, but generally the duties of that position are imposed upon the city marshal or chief of police, whose tenure of office is not so assured as to make him independent in the performance of sanitary duties, and whose fitness as a police officer is by no means compatible with fitness as a sanitary officer.

* An exception must be made with regard to Boston, whose independent board of health has just been organized.

Left in such hands, measures of public health are very apt to have indifferent administration. The execution of the law requires special tact, involves special responsibility and is surrounded by special embarrassments. For these reasons, the interests of public health tend to take a secondary rank under existing methods of municipal administration; external improvements, the preservation of order, the control of public works and the disposal of public money are, at present, of more consequence in the eyes of the city council than any abstract considerations of hygiene.

The remedy for this appears to be in the clause of the law which provides for the appointment of independent boards of health in cities and towns; for the choice of a limited number of active, expert, intelligent men, endowed with all the duties, the powers and the responsibilities which the law now gives, and holding their office during good behavior. Under such an organization, what is now compelled to share official attention with many other matters would become the distinctive business of a compact body; official circumlocution and delay would be without excuse in such hands, and prompt, energetic, independent action would be the price of office-tenure.

But next to the importance of having such a board in the abstract is the obvious necessity of its proper constitution. The choice of its members should rest, not in political preferment, but on fitness for the place. If sanitary ordinances are worthy of being executed at all, they deserve the most intelligent as well as the most thorough execution. To this end, no board of health is properly constituted which has not secured in its membership the active service of medical experience. The professional training of the physician fits one better than that of any other avocation to appreciate the sanitary needs of a community, and his daily practice carries him into the midst of conditions from which arise the sanitary exigencies demanding the attention of a board of health. He, more than any one else, knows from his daily observation where the uninhabitable tenement-houses, the overcrowded alleys, the polluted courts, the filthy yards are located, and his expert education enables him best to designate the presence, the effects and the remedy of the sanitary abuses, in all directions, from which the people ignorantly

permit their vigor and their health to suffer. In all sanitary administration, medical science, whatever other elements are introduced, should have, if not a controlling, at least a coördinate influence. Every township in the Commonwealth may well and readily avail itself of the statute privilege to have such an official sanitary supervision of its affairs. Every city ought to feel it an imperative necessity to do so.

In conclusion, the writer believes that he has not unduly magnified the importance of his subject. In detailing the facts contained in this Report, he has desired to give them truthfully and without prejudice, and in the belief that they did not require the aid of sensational elaboration to render them emphatic; they are sufficiently emphatic in the plainest garb. That they do not represent the average condition of the homes of the laboring poor throughout the State is admitted, for if they did so, our civilization would be truly degraded; they do, however, illustrate a real and a preventable condition, inconsistent with health, and constituting one of the most important fields for the work of sanitary reform.

The lesson enforced by such an inspection as is here reported is that, if it is manifestly impossible that every poor man can have a perfectly healthy habitation, it should be made practically impossible that any poor man should live in a disgracefully unwholesome dwelling.

REPORT

OF THE

BUTCHERS' SLAUGHTERING AND MELTING ASSOCIATION.

REPORT.

To the Secretary of the State Board of Health.

DEAR SIR:—In compliance with your request for a statement of the operations of the Butchers' Slaughtering and Melting Association up to the present time, I have been desired by the directors to submit to you the following Report:

The work of securing the land approved by your Board has been completed, and the rendering-house, together with one block of buildings for slaughtering cattle, one block for slaughtering sheep, the necessary stables for horses, a barn and sheds for cattle, and an engine and boiler house, are nearly ready for occupation. We confidently expected that our works would be in operation by the first of the present month; but delays unavoidable, owing to the magnitude of the enterprise and the novelty of its plan, as well as to the fact that the land had to be excavated and graded before the foundations of the buildings could be laid, have obliged us to postpone the time of commencing business for a few weeks longer. That those who feel interested in the success of the scheme we are engaged in carrying out may understand how extensive is the task imposed upon us, I give the following statement of our investments thus far:—

We have paid already for land purchased or taken under our charter the sum of (in round numbers), ...	$44,854 00
For expenses upon real estate, including drain-pipes, grading, &c., ...	5,300 00
For a wharf, as authorized by the harbor commissioners, ...	5,000 00
Carried forward, ...	$55,154 00

Brought forward, ...	$55,154 00
The corporation owes for land purchased and yet not settled for, ...	50,000 00
And has offered in settlement of land damages for land and buildings taken under its charter, and which we believe to be a sum at least equal to the fair market-value of the land so taken, .	33,636 00
Total investment for land (say 49 acres) and buildings which were standing on the same, .	$138,790 00
The rendering-house, including the chimney, tanks, driers and machinery, will cost, estimating for work yet to be done, about . .	111,000 00
The engine and boiler house, including five tubular boilers and a Brown engine of 75 horse-power, ...	18,000 00
The cattle slaughter-house, ...	55,000 00
The cattle barns and sheds, ...	8,000 00
The sheep slaughter-house, ...	22,000 00
The stables for horses, ...	10,000 00
Salaries, architect, insurance and miscellaneous expenses thus far, ...	8,000 00
Making a total of actual expenditure and liability of the corporation already incurred amounting to	$370,790 00

For its income to pay the interest on this investment the corporation looks to the rents it will receive from the leases of the slaughter-houses, and the profits it may be able to realize from the rendering-works. It will have facilities for rendering the tallow for the butchers, for which it will charge a fair rate, or it may purchase the rough tallow and manufacture and sell it on its own account. It will have the blood and refuse of the slaughter-houses, and will have as products from these sources a certain amount of tallow, soap-grease, glue-stock and dried blood, animal matter and bone. These three last are believed to be of great value as fertilizers, upon the demand for and selling-price of which the success of our experiment will largely depend.

The rendering-house is large enough for any demand that can be made upon it for many years to come. No further expenditure will be necessary at present for power. The boiler-house is designed for ten boilers. The corporation will be able, with its present facilities, to furnish heat, hot-water and steam for all the buildings now erected or contemplated, and all that will be required to do all the cattle and sheep slaughtering that is done in the vicinity of Boston. But the number of slaughter-houses must be at once increased. Probably not less than from seventy-five to a hundred thousand dollars ought to be expended on such buildings the coming year. The foundations of another block are already laid; but as these will be at once rentable, and will increase proportionately the supply of material for rendering, their erection cannot fail to be for the interest of the company. The company will also probably be under the necessity of building a number of dwelling-houses suitable for occupancy by its employés. The land of the company bounding on Market Street and Winship Avenue will afford a very desirable location for houses; and it is for the interest of all engaged in the business that they should be built speedily and that the rents should be equal to a reasonable interest on their cost, and no more.

It is obvious, therefore, that in order to meet the just requirements of the State Board of Health, the corporation has already incurred an expense far beyond what was anticipated by its charter, and that it must provide means for a much larger expenditure. Thus far the money over and above the capital subscribed has been all raised by the directors or stockholders. The stock is not yet fully subscribed for, and although it has been for some time offered to the public, is not in great demand, and perhaps it is too much to expect that it will be as long as the success of the enterprise shall remain a matter of experiment. It is very certain, however, that while the corporation may or may not realize a profit from its investment, every owner of land in Brighton or the portions of Cambridge, Newton, Brookline and Watertown near to Brighton, will derive an immediate and great benefit from the concentration of the business of slaughtering which the formation of the corporation is effecting. We have felt that such land-owners ought to aid us by subscribing to the stock of the

association, that as they certainly reap a profit from, they should be willing to share the risks of the undertaking. Thus far, however, with two or three exceptions, the subscriptions to the stock have come from those engaged in business connected with the markets; and judging from present appearances, the butchers and those associated with them will have to carry through the work from their own resources and with the aid of such sums as the property and credit of the association will enable it to borrow. We hope and believe that these resources will suffice. We certainly have something to show for every dollar expended, and the land originally purchased is probably worth to-day much more than it cost. Our location for the business proposed to be done is unsurpassed. When graded it will embrace a tract of forty-nine acres of level land, not wanted for first-class dwelling-houses, but yet dry and affording the best of foundations. Any vessel which can pass the draws can lie at our wharf. The track of the Boston and Albany Railroad runs for a long distance along our southern boundary. We have two unfailing sources for a supply of pure fresh water. On the opposite side of the stream the land is a marsh, and will not be wanted for dwellings for many years. If an abattoir can ever be established for Boston and its vicinity, it can be at the place you have designated for our association. In conclusion, I can truly say that thus far everything has been done thoroughly, for permanance, and with a determination to comply with every requirement of the Board of Health. Whatever the result may be to us pecuniarily (and the exhibit here made is sufficient to show that the corporation cannot expect for a long time to come to earn at best more than a moderate return from its outlay), in a sanitary point of view, success is already ensured. We expect long before the adjournment of the legislature to be able to show our works in practical operation.

Truly, your obedient servant,

JOHN N. MERIAM,
President B. S. and M. Association.

BRIGHTON, January 15, 1873.

HEALTH OF TOWNS.

HEALTH OF TOWNS.

[During the past year the circular letters of the Board have related to the subjects of sewerage and water-supply, and have been sent only to towns of four thousand inhabitants and upwards.

The following pages therefore refer chiefly to these subjects. The reader will, however, find other and valuable information from our correspondents concerning the causes of disease.]

Attleborough.—The water-supply is from wells, and is generally good. Some wells are too shallow; a few have been spoiled by the percolation of acidulated water from manufactories. A system of sewers is under consideration by the town, and will eventually be built.

Amherst.—The centre of the town is in need of an independent water-supply. Other parts of the town have good wells. There is great carelessness with regard to sink-drains and privies.

Amesbury is supplied with water from wells for the most part. Some families use rain-water, stored in cisterns. In some of the principal streets there are brick sewers. In other parts of the town the kitchen and sink wash are drained into the open street-gutter, or into hogsheads sunk in the earth, or thrown upon the ground.

Abington has good wells and no sewers. Fluid slops are, as a rule, carelessly thrown on the ground.

Boston.—The health report of the chief city of Massachusetts for 1872 is of an unfavorable character. The same neglect of the authorities to remove causes of disease, perfectly within their control, has continued, and their effects are seen in the extraordinary number of deaths. As a city increases, the mortality will inevitably increase more rapidly than the population, *unless the means of repressing disease keep pace with the city's growth.*

Boston has neglected such provisions, and is reaping the fruit of the neglect.

In addition to the usual causes of death, which gather intensity with every year's official negligence, Boston has had to meet an epidemic of small-pox, which is now sweeping over this and other countries with a virulence previously unknown. The effect of this unusual mortality from a special and temporary cause on the general mortality from all causes is worthy of

particular remark, and is commended to the attention of the fatalists who contend that all efforts to prolong human life are vain and useless, and that an epidemic diminishes the mortality of other forms of disease.

There died in Boston in 1871, 5,888 persons. There died in Boston in 1872, 8,089 persons. Small-pox destroyed 28 lives in 1871, and 738 lives in 1872. Reckoning the total mortality in each year, the increase in one year is 37 per cent. Excluding small-pox in both years, the increase in one year is 25 per cent.

The death-rate cannot be given because we do not know the present population. But every one will see that however great the increase may have been in the business of Boston, the number of persons resident within its territory can hardly have increased more than 5 per cent. in a single year, and probably not more than 3 per cent. We do not regret that the exact death-rate cannot be recorded, for the figures would be discreditable to the metropolis of New England.

Happily the sanitary interests of Boston are in a state of revolution. The old system (or rather want of system), of which each of the previous reports of this Board has freely spoken, has passed away, and a new management of health affairs has just now commenced. Public opinion, at last thoroughly aroused by the incapacity of the city health committee to deal with the epidemic of small-pox, has forced from a reluctant board of aldermen a portion of the powers which they possessed, and placed them in the hands of an independent board, consisting of three citizens appointed by the mayor and confirmed by the city councils. They are now just entering upon their important duties with the support and good wishes of all good citizens. They will need every encouragement from those who see the need of radical reforms, and we bespeak for them a helping hand and voice from all who have the future health and welfare of Boston at heart.

Blackstone.—"The water-supply is generally from wells; these are very often polluted by privies or sink-drains. There are some small reservoirs fed by springs, and one large reservoir supplies some fifty families from the Blackstone River, but this water is not generally used for drinking or cooking. There are some sewers of stone masonry and cement belonging to the Blackstone Manufacturing Company but none belonging to the town."

Beverly.—Our correspondent says, "Our water-supply is from Wenham Lake. The main pipes are of cement; most of the service-pipes are of galvanized iron. It seems to me that the State should institute some inquiries which would result in a satisfactory settlement of the question whether there is any danger in the use of such pipes. There seems to be a difference of opinion among those who ought to know. No cases of zinc-poisoning have come under my notice." Beverly has no sewers; with such abundant supply of water they are surely needed.

Barnstable.—"Water-supply from wells in some portions of the town. Many people have cisterns in the ground, cemented, and obtain their water-supply from the roofs of buildings. There are no sewers, and as a general rule our water-closets are nuisances. Slops are thrown everywhere, in cess-pools, pig-stys and on the ground. A few people in the larger villages have drains and closed vaults with stench-traps.

"Many cases of fever I have traced to the influence of some filthy hole around dwellings. We are however greatly favored by the nature of our soil which is a light, porous sand."

Brookline.—Water is supplied by wells for the most part, but also in parts of the town from Jamaica Pond. In a region near the line of the Hartford and Erie Railroad the springs are strongly impregnated with peroxide of manganese and oxide of iron. This water rapidly destroys lead-pipe and injures the health of those who depend on it. Our correspondent has several wells on his premises but uses by preference rain-water received in a cistern, which is divided by a partition of soft brick. The water is filtered in its passage through the brickwork.

There are two brooks (besides Muddy River) running through Brookline, which are practically sewers, but many of the foreigners living on their banks use the waters for culinary purposes. Parts of Brookline are well provided with sewers, many of which have been recently built and in the best manner. They discharge into Muddy River.*

Chicopee.—"There are wells at very many houses in this village, dug years ago, and almost wholly abandoned for the aqueduct water. Water is found almost anywhere at the depth of ten to fifteen feet, but it tastes brackish and *swampy*, much of the land now built upon having been originally a swampy pasture with alders and frog-ponds. The highest land above this village is a sand-plain, reached by an elevation from the river-level of more than a hundred feet, I think three-fourths of a mile or less from the river. In this sand wells are sunk by the aqueduct company, and water found by digging from three to ten feet, according to surface, the water, as I understand, being all on the same level. This cannot come from springs as the land is the highest for miles, but is probably held in an immense clay basin, and is therefore quite pure and good, but it is carried to the people in old logs, lead-pipes, iron-pipe, stone-pipe, &c., many of which have become decayed and brittle and call for such constant repairs that the water is kept stirred up and full of sediment much of the time. It has also for the last two or three years been kept 'shut off' during the warm months, to the great inconvenience and sometimes, in my opinion, to the injury of the health of the people. Nearly all summer no water was to be had after nine, P. M., till morning, to the great detriment in case of sickness of such as had no ice, as the taste became well-nigh insupportable after standing a few hours.

"Our main business street for commercial purposes has no sewer and no adequate drainage, and a large majority of the cellars abutting on this street are very often flooded with water. I have seen some being emptied with force-pump and hose into the streets. The Dwight Company own the land for a considerable distance between this street and the canal and Chicopee River, and I am informed are not willing to have the sewage fall into their canal, and very properly too in all probability, as they have thousands employed all day in its immediate vicinity. There should be a large, deep sewer the whole length of Exchange Street, ending on the bank of Connecticut River.

"At Chicopee Falls, another village in the town, of 3,000 inhabitants, the water-supply is better. The same remarks respecting sewage will apply to this as to the centre village."

* The difficulties which are likely to grow out of this disposition of sewage, with reference to the future growth of Boston westward, are clearly explained in a recent report of Mr. H. M. Wightman, assistant city engineer. It is another proof of the need of some comprehensive plan of drainage for the whole metropolitan district. [SECRETARY.]

Charlestown has excellent water from Mystic Pond. The people are however becoming anxious, and as we think with good reason, about the final effect of casting so much refuse into the sources of supply. The Charlestown sewers are reported to be in good condition. Our correspondent states that "there are tenement-houses on the streets bordering our city where the drainage is very poor, owing to the carelessness of the inhabitants in allowing the drains to be obstructed by solid refuse. The tide also seems to wash back the sewage and cause trouble."

Cambridge.—Our correspondent writes as follows:—

"The nuisance at East Cambridge, caused by the condition of Miller's River or Creek, is well known to the State Board of Health. Several sewers enter this river or creek and the sewage is imperfectly carried off by the tide-water, and the smell at low tide is horrible. The pork establishments on its borders add to the stench. The nuisance has become intolerable and must be abated in some way. The only feasible method of doing this seems to be by filling up the creek and constructing a trunk-sewer through it, so that the sewage may be discharged nearer the channel of Charles River.*

"I subjoin certain statistics, collected by Dr. H. O. Marcy, in relation to the health of the population in the vicinity of this nuisance.

"Population by wards, 1870:—

Ward 1,	6,909
" 2,	10,389
" 3,	9,178
" 4,	8,865
" 5,	4,311

"Whole number of deaths for five years in ward 1, 552; ward 2, 1,267; ward 3, 1,134; ward 4, 728; ward 5, 376. Total, 4,057.

"The number of inhabitants to one death, per annum, in the whole city, 48.80; Middlesex County, 49; wards 1, 62.66; 2, 41; 3, 40.45; 4, 60.90; 5, 56.

"The death-rate in wards 2 and 3 is greater than in wards 1, 4 and 5, by 20 per cent.

"Number of inhabitants to one death, per annum, in ward 1, 62.66; in ward 3, 40.45. The death-rate in ward 3 is greater than in ward 1 by 22 per cent.

"The population of wards 1, 4 and 5 in 1870 was 20,085; deaths in the wards named, 1,656. The population in wards 2 and 3 was 19,565; deaths in said wards, 2,401, showing an excess of deaths in wards 2 and 3, with a less population than wards 1, 4 and 5, of 745.

"Of the land in ward 1, 10 per cent. is marsh; ward 3, 60 to 75 per cent.

"The whole number of deaths from cholera infantum for the past five years in this city, 463; in ward 3, 133, or 35 per cent."

It will be seen that the mortality in wards 2 and 3 (which borders on Miller's River) is greater than in the other three wards combined.

Clinton.—"The Lancaster Mills supply about 150 families with water from the Nashua River, which is pumped into a reservoir on an eminence, and thence distributed to the tenements. The remainder of the town is supplied by wells. This water is generally 'hard,' containing chloride of sodium, car-

* The "Miller's River question" has been investigated by order of the legislature, and report made. See "General Report of the Board" in this volume. [SECRETARY.]

bonate of lime, and some in addition sulphate and sulphuret of iron. Most of these hard well-waters corrode lead-pipe, and are injurious to persons drinking them. I have never known of a case of lead-disease from river-water passing through lead-pipe. Lancaster Mills have sewers which convey away all the sink-wash, soap-suds, &c., which is emptied into the river below the mill. Their sewer is of brick. The liquid sewage of the rest of the town is deposited in cesspools."

Danvers.—The board of health of this town seems to be active and efficient in looking after the causes of disease, in establishing drainage, and promoting plans for a complete water-supply. Members of the medical profession are foremost in these good works.

Dedham.—The supply of water from wells is so unsatisfactory that many families rely upon rain-water cisterns Wells are subject to quicksands, and are often fouled by neighboring cesspools. Our correspondent hopes that a beautiful lake three miles from the town may supply the people with water at no distant day.

Fall River seems to be as yet but poorly provided with water and with sewers. The city has recently grown with great rapidity, and so crowded a population will evidently need large expenditures to provide for public health and safety. Extensive works for the conveyance of an ample supply of water are now in process of construction, and it is hoped they will be able to supply the city, in part at least, before the close of 1873.

Framingham.—Our correspondent reports more sickness in 1872, a year of unusual wetness, than in 1870 or 1871, years of comparative drought. In the last-named years the wells were low, and the supply of water for domestic use insufficient.

Trichina disease, which is one of rare occurrence in Massachusetts, or which is rarely recognized, has appeared in a family in Framingham since our last report.

The family of Mr. W. consists of himself, wife, a son of fifteen, a young child and a servant girl. Mr. W. killed a pig on the 2d of December, 1872. It had been raised by himself with care, fed largely with apples, and during the last six weeks of its life on Indian meal and water. It was about a year old and very fat. The family ate of the meat of this pig at four or five meals about December 18th to 20th in the form of salted (unsmoked) ham and sausages. The ham was thoroughly cooked. The sausages had been frozen and were *very slightly cooked, so that the heat had hardly penetrated the interior portions.* On Christmas day Mr. W., his wife and son of fifteen were all affected with swelling of the eyelids. This was soon followed by swelling of the whole face; a few

days later, swelling of the legs and feet, and violent pain of legs, arms, shoulders and back. Mr. W. had diarrhœa for a week. Mrs. W. was not affected in this way. Suspicions of poison were excited, and a piece of salted ham from the pig was sent to Dr. J. C. White, of Boston, for examination. The mystery was at once solved by the microscope. Dr. White discovered very numerous unencapsuled trichinæ in the muscle.

This family was visited by the Secretary of the State Board of Health, January 23d, 1873. Mr. White and his wife were still suffering a good deal of pain, but able to go about the house, and were daily improving. The boy had gone to school, still feeling somewhat stiff and sore, and complaining that he could not run. The servant girl had not been affected. She had tasted the sausage, but had eaten very little of it, and the presumption is, that the part she ate had been cooked enough to destroy the life of the trichinæ. The child had eaten no pork.

[A report of cases of trichina disease occurring in Lowell and Saxonville in 1870 will be found in second annual report of the State Board of Health.]

Fitchburg within a year has introduced water from an artificial basin of eleven acres, furnishing an excellent supply, both as regards quality and quantity. Our correspondent also writes as follows:—"During the last winter and spring we had some thirty-five cases of small-pox and varioloid. We also had epidemic measles last winter. But very little typhoid fever or dysentery for a year past, but a good deal of catarrhal fever during the past autumn. Two cases of miasmatic fever have been noted,—one caused by work on an obstructed drain, and another from carrying out, opening and burying a cask of rotten cucumbers on a hot morning in September. Both recovered under the use of quinine."

Great Barrington—This town is not properly drained, but could be by a little effort on the part of the citizens, as there is a fall of from twelve to twenty feet from the main street to the Housatonic River. In some instances large cesspools are made to receive contents of water-closets, &c., and will, in our correspondent's opinion, prove dangerous to health.

The town is supplied with water from a reservoir made by damming a stream in the mountain.

Gloucester is greatly in need of a supply of water, above suspicion, but our correspondent reports that recent ill-luck in the fishing-business will probably postpone for the present any costly improvements in this direction. There are very few towns in the State whose territory is so riddled

with privies and wells. Brooks leading to the docks and beach are used as sewers.

Grafton.—Our correspondent notes occasional instances of wells polluted by the close vicinity of sink-drains.

Haverhill.—Our correspondent writes that "A thorough system of drainage will soon be adopted by the city. The lower portions of Haverhill are as yet undrained, and are very wet, owing to a heavy clay deposit. Our water-supply comes from ponds lying near the city limits, but the upper portions are unprovided for. The water is generally of good quality."

Hingham.—Water-supply from wells unreliable. Rain-water cisterns are in some cases used.

Hyde Park now depends for its water-supply on wells, and also very generally on cisterns filled by rain falling on the roof. An independent supply from other sources will soon be needed by this growing town.

Hopkinton.—About one hundred families are now furnished with water from a spring near the centre of the town, but the supply is unsatisfactory in amount.

Holyoke.—This enterprising young city is mainly supplied with water from the Connecticut River, but a charter has been given to take water from two ponds within the township. The sewerage, now in process of construction, will be very complete.

Lynn.—This city seems to be quite aware of the need of a complete supply of pure water, and a corresponding system of sewers, to its future health and prosperity. The sources of water-supply which are really available for Lynn are numerous, and the difficulty is to choose between them. There are lakes of great purity and extent just around the city, and from some of them it is quite certain a safe and bountiful supply will be got. At present the water of Breed's Pond, to the amount of its capacity, 1,000,000 gallons daily, is distributed by about forty-five miles of street pipe. This is only about half of what is needed. There are, we think general reasons enough given in another part of this volume to make the people of Lynn hesitate before engaging to drink the water of Saugus River, which is strongly advocated as a source of supply by one of the parties into which the city is divided on the water question.

The wells of Lynn, which now furnish water to half its population, are confessedly impure.

A comprehensive plan of sewerage has been adopted, and all the principal business streets are already furnished with the means of disposing of every form of liquid waste. The sewage is discharged into the harbor, which is very shallow, and its flats much exposed by the receding tide. The final disposal of the contents of the sewers, so as to create no offence, will apparently be attended with difficulty. A plan of utilization, like that proposed by Mr. Ball for Worcester, would be well worth considering.

Lawrence.—"More attention has been paid during the past year to the improvement of the sanitary condition of the city, but as yet we have no satis-

factory system, or efficient board of health. An effort was made this year to secure a board, which should comprise medical men and others specially interested in sanitary reform, but it was not successful. An efficient board of health, with ample authority, would reduce the mortality of the city, in my opinion, very perceptibly, especially during the summer months. Lawrence, however, is improving in all respects, and when Boston sets us a good example in the composition and methods of its board of health we shall be very likely to copy it.

"Lawrence is in great need of an adequate water-supply. The supply is insufficient, except in the industrial establishments and their boarding-houses. It is thought that the only adequate supply can be obtained from the Merrimack River, which will involve an immense outlay, and the project is therefore strongly opposed by many. I presume that some plan will be adopted before many years to obviate the difficulties and overcome the objections."

Lawrence is partially supplied with sewers, and they are annually extended. The oldest sewer is built of stone-masonry, the others of brick and cement.

Marblehead.—Our correspondent reports the need of water-supply and of sewerage.

Marlborough is dependent on wells, and there is much dissatisfaction, but chiefly on account of the danger from fire.

Milford.—This town is becoming so compactly built up that a supply of water from without will soon be needed, not only for the fire department, but to avoid the danger from the corruption of wells by drains, cesspools and privies.

Newton.—This large town of many villages has various needs and conditions as regards water-supply and sewerage. Certain sections, as Newton Corner, Newtonville, West Newton and Newton Centre, would be willing perhaps to pay for a good water-supply, but the town is unwilling at present to incur the cost, although the question has already been much discussed, and must be in the future. Auburndale has springs from which water is conducted by pipes. Upper and Lower Falls have the river for all fire-purposes, and wells for domestic use. The well-water at Newton Corner has been proved to be impure, and is no doubt contaminated by the sewage of dwellings and stables. In one case, where analysis was made by Dr. J. R. Nichols, it was found to have 11.65 grains of solid contents to the gallon, of which 4.95 were of organic materials, and this was better water than most of the wells furnish, and more remote from defiling influences.

Newburyport is not satisfied with its water-supply from wells, and a good many families use filtered rain-water. The city is drained by a natural slope to the river, which receives liquid refuse by gutters and superficial conduits. Our correspondent reports the health of Newburyport to be remarkably good, and states that during the summer of 1872 they were exempt from mortality among children to a degree unusual in places of equal population.

New Bedford is supplied with water from Acushnet River, which is pumped to a reservoir at sufficient elevation to distribute it throughout the city.

Natick.—Our correspondent reports as follows: "Our water-supply for both domestic and fire purposes has been very poor during the past two

years. At the last March meeting the subject was discussed and preliminary steps taken to procure a better supply.

"There is no system of sewerage, but our principal village is so compactly built that great nuisance must soon result unless some extensive and general plan is adopted. Then will arise a very important question, Where shall our sewage be delivered? Our natural drainage is into Lake Cochituate, and how will this affect the purity of the Boston supply? At present it probably does not affect it. Still the probability of its doing so increases year by year with the growth of this village. Should there be any system adopted for a supply of water for this part of Natick, it must be by drawing the water from Lake Cochituate, and then returning it again in the waste-form to the lake. This would affect other interests than our own. The subject impresses me as one of great future importance." *

North Adams.—Water for this village is from a stream running down the northern slope of "Graylock Mountain," and is very pure. Since the introduction of this water wells in the village are dispensed with for the most part; they were in too close connection with privies and cesspools to be safe.

Peabody.—Our correspondent in this town describes the same stream referred to in letter from Salem (North River) at a higher point, where it is formed by the confluence of Goldthwaite's and Proctor's Brooks, as "the grand and only sewer in Peabody for the drainage of street-surface overflow, and of the various manufacturing establishments. Among them are print-works, a bleachery, many tanneries, and some morocco-dressing factories and glue-factories. It also drains two slaughter-houses, in one of which five thousand cattle and thirty thousand sheep are annually killed." A dam which existed on this stream in Peabody was happily removed two years ago, and the stream has been closed on all sides with plank, and the old pond-bed filled up solid. "This has wrought a great change in the sanitary condition of the town, for whilst the waters were dammed up, this pond-bed, which in summer was but slightly covered, was the receptacle of all the refuse from the establishments above named, and was a seething mass of corruption, a breeder of disease, and at all times an eyesore of the worst description. This state of things is done away with at this point, but still exists lower down at Frye's Mills."

Peabody is supplied with water of excellent quality from the pipes of the Salem and Danvers Aqueduct Company, and from other reservoirs, but there is a strong desire to have a still larger and more constant supply from the Wenham Lake Company.

Plymouth is supplied with water of great purity and in abundance, from a lake five miles distant.

Pittsfield.—"In its *water-supply* our town is particularly blessed, receiving from Ashby Lake, seven miles distant to the east, at a great elevation above the town, an unfailing supply of the purest spring-water. The supply is sufficient, even in the winter, when every faucet is kept constantly open to prevent freezing. The water of the lake is conveyed to a reservoir two miles down the mountain by a tumultuous brook, joined by other brooks on the way. From the reservoir the water previously filtered through gravel is brought to the town by iron pipes.

* The attention of the people of Boston is called to the above remarks of the late Dr. Lincoln, of Natick. [SECRETARY.]

"Since the introduction of the water, no epidemic, or fever (excepting the local one at Maplewood) has been known in Pittsfield, and the health of the town has in every way improved. The fact is a very striking one, and made more so by each year's observation, that the great majority of our cases of fever are outside of the Ashby water-supply.

"The present year the number of fever cases, although moderate, has been somewhat greater than usual, but scarcely one has come under my observation in any house supplied with the Ashby water.

"The fever at Coltsville was mentioned in my report of last year, and I can now add something to its history. The present season there have been, to my personal knowledge, seven cases of typhoid fever in that vicinity; and the indications are that there will yet be others. Among these one death has occurred. For several years fever has prevailed in that locality, and the reason why can hardly yet be said to be determined. The settlement consists of a dozen houses, clustered about a paper-mill, and very near the banks of a shallow and rapid stream, the ground rapidly rising on either hand. It is thus a shut-in locality, where the sun acts powerfully, and but little air is stirring. The soil is dry and sandy, the wells mostly old, some of them having been dug thirty years ago. There are two artesian wells, however, of great depth, for the mill and the workmen in the mill, and the occupants of the houses close by drink the "hard" water which these furnish. The man who died of fever this summer drank artesian-well water; but most of the sick used well-water. In one house was a boy very sick with typhoid. The house was very neat both in its interior and surroundings. The well, however, which is thirty years old, had been cleaned out, and a new pump had been put in, just a fortnight before the boy was taken sick, and I have little doubt the stirring-up process had contaminated the water. The soil is so porous in this vicinity that a rise in the river immediately affects some of the wells, and this would tend to allow surface-washings to find their way speedily into the wells. There is one family in which three cases of fever have successively occurred. In this case, the intolerable filthiness of the house and its occupants renders it unnecessary to suppose any more remote cause. The smell of the rooms is sickening, notwithstanding the neighbors have made an invasion with mop and soap.

"Adjoining Coltsville, and extending up the same river for three or four miles, lies the village of Dalton, with five paper and three woollen mills. The Dalton valley is narrow, though not quite as much shut in as Coltsville, and has for many years been a favorite haunt of typhoid fever. Now, it seems probable that some endemic cause exists in Dalton and Coltsville beyond the mere local, or, as we may say, *domiciliary* causes, which are about the same in all country towns. I think there is no doubt that this cause is the river, which, narrow and shallow, dammed at frequent intervals, receiving the waste and sewage of many factories, and flowing through a contracted valley, where the air is stagnant and the sun is hot, poisons the air in its vicinity, and adds a general cause to the many special causes of typhoid fever. It is true, that most of the factories are paper-mills, in which chloride of lime is used in large quantities for bleaching, and that much of this finds its way into the river; but the quantity is not sufficient to disinfect the whole river.

"The past summer has been characterized by unusual *heat* and *moisture;* and the general prevalence of summer diseases is as follows:—*Typhoid fever,* slightly increased; *dysentery,* none at all; *cholera morbus,* very severe, and

prevalent; *cholera infantum* and *infantile diarrhœa*, unusually prevalent, and exceedingly fatal.

"The number of deaths among children under two years of age has been very large, especially among the Irish and the bottle-fed. Each period of excessively hot weather with the cool days following, has been a period of fatality among infants.

"As yet, our town is but partly *sewered*. A three-feet brick sewer is carried through the principal business street, and a few other streets have eighteen-inch pipe of Scotch tile. These all empty into a four-feet brick sewer which empties just below the dam at Pomeroy's factory. Until last year, it emptied into the mill-pond, above the dam; and I think there has been a decrease in the amount of sickness in that vicinity since it was carried below the dam."

Rockport.—"Although the water used for drinking and cooking in this town is mainly from wells, and is generally good, there is one locality, embracing five houses, in which it is obtained from springs through lead pipes. As these pipes are kept constantly running, it has been thought that there was no danger of the water becoming contaminated so as to compromise the health of the families using it. Without committing myself to any opinion on the subject I present some facts which, if they do not point to the slow contaminating influence of lead, must be regarded as singular coincidences. These houses were built between thirty and forty years ago. Two of them have changed their inmates several times; the other three were built and occupied by the same families until last Christmas, when the head of one of the three families died. He had been extremely deaf, and totally blind from cataract for some years previous, and was seventy years old. His son, and only child, died of consumption twelve years since. His widow survives.

"In another of these houses, in a family of seven grown-up children, two are affected with amaurosis. In the third, the father, aged seventy-one, is very deaf; the mother has cataract. One of the five children died of chronic dysentery, two married young and left the homestead, and two have been long absent in California.

"No direct signs of lead-poisoning have ever appeared in any member of these families, yet that there should occur two instances of deafness, two of blindness, and two of amaurosis among nineteen persons below the age of seventy is sufficiently anomalous to excite inquiry as to the causes which have brought about such results. I submit these facts, hoping that through your extensive correspondence light may be thrown on this question."

Stoneham.—The water is from wells, and on the whole is unsatisfactory, both as regards quality and quantity. The sewage goes into a sluggish rivulet which passes through the village. The rivulet, or ditch, is uncovered. Drains are of the poorest description, made of stones rudely thrown together; they are too small, get choked up, and are almost useless.

Springfield.—Our correspondent gives much interesting information, which we quote in full:—

"The present water-supply of this city is inadequate. About one-half the city is supplied by wells or springs immediately adjoining the premises; the remainder of the city by the aqueduct company. This company has proved unequal to supplying the demands, and the whole matter of water-supply is

now in the hands of a board of commissioners, chosen by the people. This board are now actively engaged in this matter, and a bountiful and permanent supply will, undoubtedly, soon be furnished. An analysis of the aqueduct water and the water from five wells in different parts of the city gave the following results:—

General Quality of Water for City Use.

	Kind of organic matter.	Mineral matter.	Organic matter.	Total.	General quality of water.
Aqueduct Comp'y,	Objectionable,	1.64	1.22	2.86	Objectionable.
Well No. 1, . .	Bad, . .	14.83	3.08	2.86	Bad.
2, . .	Bad, . .	7.82	2.03	9.85	Bad.
3, . .	Objectionable,	9.38	2.66	12.04	Bad.
4, . .	Not bad, .	8.81	2.01	10.82	Bad.
5, . .	Bad, . .	11.53	1.91	13.44	Bad.

"Much of the impurity in the wells was due to the proximity of drains, cesspools, &c., and general surface-drainage.

"The system of sewerage is inadequate and objectionable. The surface to be drained is, first, a broad plateau ten to twelve feet above the ordinary surface-water of the Connecticut River; next, an irregular plateau one-half mile distant from the plain, and reached by a well-defined ascent. The sewers empty directly into the river, and during high-water the sewer is submerged and the river-water flows in, damming up the sewer-water and soaking into cellars and lower portions of the plain.

"The sewerage from the ascent to the plateau is through sewers emptying directly into the sewers on the plain. The upper plateau itself is badly sewered, much of the drainage being through drain-pipe into cesspools, in close proximity to dwellings.

"With no general plan or system of drainage for the whole corporation, but only a care for the immediate and separate needs of different localities, the total result is a few well-made, well-laid sewers, running from the upper plateau, through a few of the principal streets, direct to the river, while the greater portion of the drainage is through the Town Brook, a crooked, shallow, sluggish-flowing stream, partly covered and partly open (dividing in the centre of the business portion of the city and emptying into the Connecticut by two mouths, one mile apart), slowly turning over and exposing to the sun in its course the material poured into it from house-drains and sewers and slowly bearing the putrefying mass to the river, save in high-water, when a return current floods many cellars and saturates the adjoining banks with the 'seeds of disease'; while in the portion of the city supplied with good sewers the whole atmosphere is tainted by the noxious gas which pours out from numerous sewer-wells, untrapped and communicating freely with the outer air. In fact, every precaution seems to be taken to prevent the foul air from going anywhere except among the dwellings of the citizens.

"In connection with the subject of town-drainage, I am personally much interested in the subject of house-drainage in this neighborhood, and am surprised at the ignorance of, and unbelief in the need of thorough ventilation of drains and soil-pipes. The general belief seems to be that a water-seal

one-half to one inch in depth is *all* that is needed to keep the sewer-gas from the interior of the building. No more fatal belief can be held, and the result is, drain-pipes, soil-pipes and waste-pipes so arranged that a slight extra pressure of sewer-gas forces the water-seal and distributes the poison all over the house. The water-seal, or trap, as generally used, will only resist a slight pressure, and thorough ventilation is a safe and reliable means of preventing undue strain.

"A common arrangement here is to carry the soil-pipe from the upper water-closet to the drain without ventilation, trusting entirely to the S trap below the closet to keep back the gas. A column of water three to four inches deep *might* hold it, but as generally arranged it is useless against an extra pressure of gas, and I have seen the gas escape in bubbles from the top of a water-seal, two inches in depth. If the soil-pipe were carried from the drain to the top of the house, opening above the upper level of all windows, and *only* the pipes from the water-closets, trapped as at present, allowed to enter it, the hygienic condition of our dwellings would certainly be much improved, and the present practice of ventilating our 'closets' all through our sleeping-rooms be done away with. Another objectionable practice is to allow the waste-pipes from bath-tubs and wash-basins to empty into the soil-pipe. The soil-pipe should be for 'excreta' alone, and another pipe, provided with a separate entrance into the drain, be used as a common waste-pipe; * otherwise you run the risk of ventilating your soil-pipe through the waste-pipes. In building a house, a flue devoted especially to ventilation can be carried up in the chimney. The objection to ventilating your drain simply by a gutter-pipe, as sometimes done, is that in a house built with a 'French roof' the pipe opens below the level of windows; and secondly, the gutters are performing their duty when they are most needed as ventilators, viz., during a rain-storm.

"That this is not simply theory I have proof in my own residence, both of a previous faulty arrangement and consequent unpleasantness and danger, and a successful remedy by a new arrangement as just described.

"During the first five months of this year (1872) scarlet fever prevailed in Springfield. There were 33 deaths from this cause in a mortality of 274 from all diseases. During the same period there were 48 deaths from consumption; a large proportion of the latter among the foreign population, who live in a low and damp portion of the city. The city clerk tells me that reported deaths from consumption are less numerous, proportionately, now than ten years ago, and that the diminution has been gradual during that period.

"During the autumn bilious and bilious remittent fevers have prevailed with moderate intensity. This form of fever is often confounded with typhoid in this neighborhood. The soil in the lower part of the city is the rich bottom-land of the Valley, and may readily be associated with bilious derangements as seen in a truly malarious district.† (Perhaps the malaria

* The reader will observe that this recommendation does not in all respects correspond with advice on the same subject on the twenty-fourth page of this volume. It is there supposed that free ventilation of a *single* conduit, into which all refuse fluids are received, is sufficient. [SECRETARY.]

† This occurrence of autumnal fevers of a remittent or periodic type in the Connecticut Valley, as noted by our correspondent, is confirmatory of opinions expressed in a paper on "the causes of typhoid fever" (Second Report of this Board), and also in another on "mill-dams and water-obstructions" (Third Report of this Board). [SECRETARY.]

about here is not intense enough to produce marked chill and fever.) A more complete and wide system of sewerage will no doubt do much to lessen the intensity and frequency of this disease.

"The too numerous shade-trees and their proximity to dwellings, especially of the better class, have a bad influence on health."

Salem.—"One of the most dangerous sources of infection in the Commonwealth is created by the low banks and flats along the 'North River.' On the upper part of this estuary are numerous tanneries. The washings from macerated hides find their way directly to the river. Numerous outhouses are built so that their deposits fall upon the open banks. Many private drains open into it. The carrion-like odor of the stream invites contributions of dead animals or whatever may emit foul smells, for here any individual stink would be lost in the general rankness. The river with sluggish current, at ebbing tide lets fall its disgusting burden along the flats, where under the summer sun it annoys and sickens many. We are filled with apprehensions when we think of this hot-bed for the multiplication and dissemination of the cholera poison, should any outbreak of this epidemic occur."

Southbridge.—The water-supply for domestic use is deficient, and poor in quality. The river running through the town from east to west is defiled by the waste of numerous factories. Our correspondent says, "A general law of the State is needed authorizing towns to take water from sources of purity and plenty without the liability to litigation with corporations which control the water-shed of the larger rivers. A law is also desirable which shall compel the utilization of the excrement dropped into the streams by the operations employed in the large mills, and forbid contamination of the water by drugs and chemicals, so largely used in printing, dyeing and bleaching."

Stoughton.—Our correspondent informs us that while the water-supply is generally good and satisfactory, there are many instances in which it is rendered so impure by the proximity of privies and stables, that recourse is had to neighboring wells more favorably situated

West Roxbury.—As population increases there is more and more complaint of wells, and also increasing need of sewers. Many citizens look for relief from these evils in annexation to Boston.

Webster is fortunate in having an intelligent physician on its board of health. This town has adopted a health code very similar to that of Wakefield, which has been distributed among its citizens. Webster needs both water-supply and sewerage, and we doubt not, with the attention which can be directed to these wants by its health authorities, it will in due time be provided with all which the public safety requires.

Watertown is dissatisfied with its wells, and is looking towards Charles River for a better supply of water.

Waltham has gone a step farther, and is hoping to be supplied from Charles River in July next. The wells of Waltham show evidence of contamination by sewage.

Wakefield.—This prosperous town is taking a leading part in sanitary reform. The chairman and secretary of the board of health of Wakefield

are physicians, and are doing a work which should, and we doubt not does, secure them the thanks of their townsmen. The public health and safety are not left in doubt through any man's carelessness or ignorance. The following code of regulations has been issued by this board, and we have reason to believe is strictly enforced. It has already been copied by several other towns, and may well serve as a guide for very general adoption, with such modifications as the peculiar circumstances of towns, as regards population, site, occupation of the people and similar local distinctions, may seem to require.

(Copy.)

Board of Health Regulations.*

The board of health appointed by the town, hereby make and publish, as required by law, the following "Regulations for the Public Health and Safety":—

Prevention of Disease.—Privies.

Reg. 1.—No privy or water-closet not having a water-tight vault, or such vault with a water-tight drain, to convey the contents to a proper reservoir, shall be established within two rods of any well, spring or other source of water used for culinary purposes; and such reservoir shall be at least two rods from any such water source. Provided, however, that earth-privies or closets, where dry earth or ashes is daily added to the deposit vaults, in sufficient quantity to absorb all moisture, and the entire contents are removed weekly, may be so established.

Reg. 2.—No privy-vault shall open into any stream, ditch or drain, except common sewers, or in the manner specified in Reg. 1.

Reg. 3.—Within the limits bounded by Lawrence Street, north, Water Street, south, Railroad Street, west, and Vernon Street, east (including the houses on both sides of the said streets), no night-soil shall be removed from any premises until ten o'clock at night.

Parties removing night-soil outside the limits specified, are recommended to cover their loads with dry earth whenever removed by day.

Drains, etc.

Reg. 4.—No sewer-drain, not water-tight, shall pass within two rods of any well or other source of water used for culinary purposes.

Reg. 5.—No sewer-drain shall empty into any lake, pond or other source of water used for culinary purposes, within the limits of this town.

Reg. 6.—No house-offal, dead animals, or refuse of any kind shall be thrown upon the streets by any resident; and no butcher, fishmonger, or vendor of merchandise, shall leave any refuse upon the streets of this town.

Reg. 7.—All families are required to have a proper covered receptacle for swill and house-offal, and to cause the contents to be regularly removed as often, between the first day of June and the first day of September, as twice a week, and once a week at all other seasons.

It is recommended by the board, that wherever surface-drainage is used for the waters of sinks or cellars, that the soil be frequently renewed; and it is also earnestly recommended, that all cellars be thoroughly drained, when practicable.

* The Board shall make such regulations as it judges necessary for the public health and safety. * * * * Whoever violates any such regulation shall forfeit a sum not exceeding one hundred dollars. [*Ext. General Statutes, Chap.* 26, § 5.

Hogs, Goats, etc.

Reg. 8.—No hogs or goats shall be kept within the limits specified in Reg. 3, except in pens kept free from standing water, and regularly and freely disinfected; and no hogs shall be kept with 100 rods of any dwelling else where, except the pens be kept free from standing water.

The board will order the removal of such animals within the specified limits, in any case where they may appear to be prejudicial to the public health, safety or comfort.

Diseased Animals, Sale of Food, etc.

Reg. 9.—No animals affected with an infectious or contagious disease, shall be brought within the limits of this town. No diseased animal, or its flesh, shall be sold or offered for sale; and no decayed, diseased, or unfit meat, fish, vegetables, fruit or other article of food, shall be so sold or offered for sale.

Reg. 10.—No person shall sell, or offer for sale adulterated milk, or milk produced by animals improperly fed; and whoever is supplied with milk, which there is good reason to believe is adulterated or is so produced, shall at once submit the same, with the name of the seller, to the inspector of milk.

Slaughter-houses, etc.

Reg. 11.—No slaughter-house or abattoir shall be established or used as such within the limits specified in Reg. 3, and none elsewhere within the limits of the town, unless kept free from all obnoxious smells, and all offal be removed daily.

No melting or rendering-house shall be established or used as such, within the limits of the town, except by special permission and location of this board.

Reg. 12.—No manufacturing or other business, giving rise to obnoxious or injurious odors, shall be established or continued within town limits, except in such locations as this board shall assign, and all existing manufactories, stables, etc., shall use all means available to render themselves inodorous and non-objectionable.

Reg. 13.—All putrid or decaying animal and vegetable matter must be removed from all cellars and outbuildings, on or before June 1st, and if not buried, must be deposited at least fifteen rods from any highway.

Reg. 14.—No fish, slaughter-house offal, or other decaying animal matter, shall be left upon land for purposes of fertilization, without being ploughed in or otherwise rendered inoffensive.

Vaccination.

Reg. 16.—Every child must be vaccinated before *two years* of age. The board earnestly recommend that all children shall be vaccinated before *six months* of age, and that all persons be re-vaccinated as often as once in five years.

Reg. 16.—All persons above two years of age who have never been vaccinated must be vaccinated immediately.

Reg. 17.—All incorporated manufacturing companies in this town shall cause each new employé to be vaccinated on entrance, unless proof is furnished of successful vaccination within five years.

Reg. 18.—The provisions of the 17th Regulation shall also apply to the keeper of the almshouse in reference to each new permanent occupant.

Reg. 19.—No person, teacher or scholar, shall become a member of any public school until vaccinated, unless furnishing to the school committee the certificate of a regular physician of this town that he or she has been successfully vaccinated within five years.

Reg. 20.—The school committee are required to demand such certificates before granting permits to scholars or appointments to teachers.

Restriction of Disease.

Reg. 21.—Any householder, in whose dwelling there shall break out a case of cholera, yellow fever or small-pox, shall immediately notify the board of health of the same, and, until instructions are received from the board, shall not permit any clothing, or other property that may have been exposed to infection, to be removed from the house, nor shall any occupant take up residence elsewhere without the consent of the board.

Reg. 22.—Any physician who may be called to a case of either of the diseases specified in the foregoing regulations, shall at once report such case to the board, and receive their instructions in regard thereto, and whenever there shall come under the observation of any physician such number of cases of scarlet fever, measles, typhoid fever, dysentery, or "spotted fever," so called, as in his opinion to justify the belief that a considerable epidemic thereof exists, he shall at once report the same to the board, with such suggestions in regard thereto as may seem to him expedient.

Reg. 23.—No person sick with any of the diseases specified in Reg. 21, shall be removed at any time except by permission and under direction of the board of health.

Reg. 24.—Persons affected with either of the diseases specified in Reg. 21, and all articles infected by the same, must be immediately separated from all persons liable to contract or communicate the disease, and none but nurses and physicians will be allowed access to persons sick with these diseases.

Reg. 25.—All vessels used by such patients must be emptied immediately after use, and cleansed with boiling-water.

Reg. 26.—Persons must not leave the premises until they, together with their clothing, etc., shall have been disinfected, and permission given by the board of health.

Reg. 27.—All bedding and personal clothing affected with contagion or infection, which can without injury, must be washed in boiling-water.

Reg. 28.—Infected feather-beds, pillows, and hair mattresses, must have their contents taken out and thoroughly fumigated, and their ticks washed in boiling-water. Infected straw and excelsior mattresses must have their contents removed and buried, and their ticks washed in boiling-water. Infected blankets, sheets, and pillow-cases, and all articles in contact with, or used by the patient, must be washed in boiling-water.

Reg. 29.—Personal clothing and bedding, particularly comforters which cannot be wet without injury, must be disinfected by baking or by fumigation, but no article must be burned without the direction of the board of health, and all disinfection and fumigation not specified in Regs. 27, 28 and 29, must be done by or under the direction of the board.

Reg. 30.—No person or article liable to propagate a dangerous disease shall be brought within the limits of this town, without the special consent and direction of the board; and whenever it shall appear to any person that

such person or article has been brought into the town, immediate notice thereof shall be given to the board, and, if such person or article remains within the town, the location thereof.

The Board earnestly bespeaks the coöperation of every individual in securing the desirable sanitary condition to promote which the foregoing regulations are framed.

All parties desiring night-soil removed may leave their orders with the secretary of the board.

All citizens are requested to notify the board of any existing nuisance or cause of injury to health. Per order of the board.

(Signed,) CHAS. JORDAN, M.D., *Chairman.*
AZEL AMES, Jr., M.D., *Secretary.*

WAKEFIELD, May 1, 1872.

Woburn.—The water-supply has been deficient, but pipes are now being laid from Horn Pond. This pond now receives a large proportion of the sewage of the town, directly and indirectly, and the inevitable effect of taking its waters for domestic use must be to remind the citizens of the urgent need of sewers to carry the sewage of the houses and the numerous tanneries to Mystic River below Medford. With such an arrangement, and a protection of its banks, Horn Pond can be kept pure forever, but unless measures are soon taken to prevent this defilement its bed will become a settling-basin for filth, and its waters will be unsafe to drink.

At several large leather manufactories in Woburn the tannery-waste is either filtered or its insoluble portions allowed to subside in reservoirs, from which it is subsequently removed to be used as a fertilizer. This plan is to be commended most certainly on sanitary grounds, but our readers will find in another part of this volume evidence enough to show that even when water so treated appears clear, it still contains soluble materials of a kind unfitting it to be added to any source used for the supply of drinking-water.

SMALL-POX IN MASSACHUSETTS DURING THIRTEEN MONTHS ENDING WITH FEBRUARY 1ST, 1873.

On the fourth page of the present volume will be found an Order passed by the House of Representatives, January 21st, 1873, directing the State Board af Health to report the number of cases of small-pox in the State in 1872 and the first month of 1873, the number then existing, and the supposed cause of the appearance of the disease in each town.

The required information was sent to the legislature on the 8th of February, 1873, and is here recorded, with the addition of returns from twelve towns making report after our reply to the Order was presented, and while this volume was in press.

One hundred and ninety-seven (197) cities and towns report cases of small-pox or of varioloid as follows:—

Cities and Towns.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Acton,	3	–	Boston.
Acushnet,	1	–	New Bedford.
Adams,	34	–	Paper-rags.
Agawam,	3	2	Unknown.
Amherst,	1	–	Unknown.
Andover,	3	–	Boston.
Arlington,	15	–	Unknown.
Ashburnham,	9	1	Athol and Boston.
Ashby,	1	–	Charlestown.
Ashland,	5	–	Boston.
Athol,	7	–	Boston and New York.
Attleborough,	14	7	Lynn, New York, Boston, Providence and Somerset.
Auburn,	2	–	Spencer.
Amesbury,	36	3	Boston.
Becket,	4	–	Canada.
Bedford,	2	–	Boston.
Bellingham,	9	–	Travelling.
Berlin,	1	–	Boston.
Billerica,	4	–	Boston.
Blackstone,	10	–	Paper-rags.
Bolton,	1	–	Boston.
Boston,	3,187	232	New York and Philadelphia.
Braintree,	12	5	Boston.
Bridgewater,	5	–	Boston.
Brighton,	8	2	Boston.
Brookfield,	11	–	Boston.
Brookline,	16	2	Boston.
Burlington,	1	1	Boston.
Cambridge,	237	22	Unknown.

Cities and Towns.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Canton,	4	–	Boston.
Carver,	9	1	Unknown.
Charlestown,	294	36	Boston.
Chatham,	1	–	Boston.
Chelmsford,	2	–	Lowell.
Chelsea,	144	11	Boston.
Chicopee,	11	3	New York and Boston.
Cohasset,	3	–	Boston.
Cummington,	19	–	Paper-rags.
Dalton,	6	–	Lee.
Danvers,	3	1	Boston and Marblehead.
Dartmouth,	21	–	Boston.
Dedham,	8	1	Boston.
Deerfield,	1	–	Greenfield.
Dennis,	2	–	Boston.
Dighton,	17	–	Rags.
Dover,	5	–	Boston.
Duxbury,	1	–	Boston.
Douglas,	3	–	Boston.
East Bridgewater,	2	–	Boston.
Easthampton,	5	–	Buffalo.
Easton,	2	1	Boston.
Edgartown,	7	–	Boston.
Egremont,	1	–	New York.
Enfield,	2	–	Boston.
Essex,	3	–	Gloucester.
Everett,	11	3	Boston and Charlestown.
Fairhaven,	3	–	Boston and Dartmouth.
Fall River,	20	–	Boston.
Falmouth,	1	–	Boston.
Foxborough,	7	1	Boston.
Franklin,	6	–	Boston.
Fitchburg,	24	1	Paper-rags and Boston.
Framingham,	11	1	Unknown.
Georgetown,	2	1	Boston.
Gloucester,	88	17	Boston and Philadelphia.
Great Barrington,	1	–	Unknown.
Greenfield,	1	–	Montague.
Groton,	3	–	Boston and Manchester.
Groveland,	1	1	Haverhill.
Hanover,	1	–	Boston.
Harwich,	1	–	Boston.
Haverhill,	12	2	Amesbury.
Hingham,	5	1	Boston.
Holbrook,	1	–	Boston.
Holliston,	11	–	Boston.
Holyoke,	32	–	Paper-rags.
Hopkinton,	1	–	Milford.
Hull,	4	–	Unknown.
Huntington,	3	–	Paper-rags.
Hyde Park,	7	1	Boston.
Ipswich,	3	–	Salem and Boston.
Kingston,	1	–	Boston.
Lakeville,	3	–	Boston.
Lancaster,	1	–	Canada.

CITIES AND TOWNS.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Lawrence,	37	6	Provincetown.
Lee,	14	1	Rags.
Leicester,	1	–	Southbridge.
Lenox,	4	–	Poughkeepsie, N. Y.
Leominster,	1	–	Boston.
Lexington,	13	3	Boston.
Lincoln,	1	–	Concord.
Littleton,	1	–	Boston.
Lowell,	17	–	Boston.
Lynn,	92	16	Boston.
Lynnfield,	1	–	Unknown.
Malden,	39	2	Boston.
Manchester,	1	1	Boston.
Marblehead,	35	5	Boston.
Marlborough,	12	6	Boston.
Marshfield,	1	–	Boston.
Mashpee,	1	–	Martha's Vineyard.
Mattapoisett,	1	–	Boston.
Medford,	14	2	Boston.
Medway,	29	–	Worcester and Milford.
Melrose,	12	1	Travelling.
Methuen,	2	1	Boston.
Middleborough,	8	–	Philadelphia and Boston.
Middlefield,	3	–	Springfield.
Milford,	12	–	Boston and Charlestown.
Millbury,	5	–	Graniteville, R. I.
Milton,	5	–	New York and Boston.
Montague,	2	–	Boston and Greenfield.
Montgomery,	6	–	Rags.
Nantucket,	1	–	Savannah.
Natick,	45	2	Boston.
Needham,	12	2	Unknown.
New Bedford,	13	–	Philadelphia, Boston, Bridgewater and Dartmouth.
Newburyport,	19	3	Boston.
Newton,	19	1	Boston.
Norfolk,	3	2	Boston.
North Andover,	1	–	Boston.
Norwood,	1	–	Boston.
Northborough,	1	–	Boston.
North Bridgewater,	15	6	Boston.
North Brookfield,	9	–	Boston and Barre.
Northampton,	9	1	New York.
North Reading,	1	–	Boston.
Norton,	8	8	Boston.
Orleans,	2	–	Boston.
Palmer,	1	–	Boston.
Peabody,	30	16	Boston.
Pembroke,	2	1	Abington and Boston.
Pepperell,	1	–	Travelling.
Pittsfield,	2	–	Unknown.
Plymouth,	15	2	Boston and Philadelphia.
Plympton,	11	–	Boston.
Princeton,	5	–	Boston.
Provincetown,	24	1	Boston and Philadelphia.
Quincy,	25	–	Boston.
Randolph,	4	1	Boston.
Raynham,	1	–	Boston.

Cities and Towns.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Reading,	2	–	Boston.
Revere,	8	–	Boston.
Rockport,	2	–	Boston.
Rehoboth,	1	–	Providence.
Salem,	65	8	Chicago and Boston.
Salisbury,	2	–	Newburyport.
Sandisfield,	1	–	Unknown.
Sandwich,	1	–	Boston.
Saugus,	7	–	Boston.
Scituate,	2	–	Boston.
Seekonk,	2	1	Providence.
Sherborn,	10	–	Boston.
Shirley,	1	1	Charlestown.
Somerset,	3	–	Unknown.
Somerville,	61	2	Boston, Cambridge and Charlestown.
South Hadley,	8	–	Holyoke.
Southborough,	1	–	Boston.
Springfield,	44	12	Canada, New Haven.
Stoneham,	14	1	Boston.
Stow,	2	–	Concord.
Sturbridge,	1	–	Boston.
Sudbury,	1	–	Unknown.
Swampscott,	2	–	Boston.
South Scituate,	3	–	Boston.
Taunton,	12	–	Boston.
Tisbury,	7	–	Chilmark, Boston.
Topsfield,	2	–	Boston,
Truro,	2	–	Charlestown, Boston.
Upton,	1	–	Savannah.
Wakefield,	14	4	Boston.
Wales,	2	1	Springfield.
Walpole,	8	3	Boston, Cambridge, Abington.
Ware,	9	–	Boston, Canada.
Wareham,	3	–	Fall River, Plympton.
Warren,	1	–	Boston.
Watertown,	10	–	Boston.
Wayland,	3	–	Boston.
Webster,	1	1	Unknown.
Wellfleet,	2	–	Boston.
Westborough,	7	–	Chicago, Framingham, Cambridge.
West Boylston,	1	–	Rags.
West Brookfield,	2	–	Unknown.
Westfield,	8	–	Hartford.
Weston,	4	–	Boston.
Westport,	27	7	Boston.
West Roxbury,	10	1	Boston.
West Springfield,	12	4	Rags.
Whately,	1	–	New York.
Williamsburg,	2	–	Boston.
Williamstown,	1	–	Concord, N. H.
Winchendon,	4	–	Boston.
Winchester,	10	1	Boston, Charlestown.
Winthrop,	8	–	Boston.
Woburn,	14	2	Cambridge, Boston.
Worcester,	24	2	Boston.
Waltham,	17	1	Emigrant vessel, Boston, and other towns.
Totals,	5,606	502	

One hundred and twenty (120) towns report that no cases of small-pox or varioloid have occurred. They are as follows :—

Alford.
Ashfield.
Ayer.

Barre.
Belchertown.
Belmont.
Berkley.
Bernardston.
Blandford.
Boxborough.
Boxford.
Boylston.
Bradford.
Brimfield.
Buckland.

Chesterfield.
Carlisle.
Charlemont.
Charlton.
Cheshire.
Chester.
Chilmark.
Colrain.
Conway.
Clinton.

Dana.
Dracut.
Dudley.
Dunstable.

Eastham.
Erving.

Freetown.

Gardner.
Gill.
Goshen.
Gosnold.
Grafton.
Granville.
Greenwich.

Heath.
Hadley.
Halifax.
Hamilton.
Hanson.
Hardwick.
Harvard.
Hatfield.
Hinsdale.
Holden.
Holland.
Hubbardston.
Hudson.

Lanesborough.
Leyden.
Longmeadow.
Lunenburg.

Mansfield.
Marion.
Maynard.
Medfield.
Mendon.
Middleton.
Monroe.
Monson.
Monterey.

New Ashford.
New Braintree.
New Marlborough.
New Salem.
Newbury.
Northbridge.
Northfield.

Oakham.
Orange.
Otis.
Oxford.

Paxton.
Pelham.
Peru.
Petersham.
Phillipston.
Plainfield.
Prescott.

Richmond.
Rochester.

Rowe.
Rowley.
Royalston.

Sharon.
Sheffield.
Shrewsbury.
Shutesbury.
Southbridge.
Southwick.
Spencer.
Stockbridge.
Sunderland.
Sutton.
Swanzey.

Templeton.
Tewksbury.
Tolland.
Townsend.

Tyngsborough.
Tyringham.

Uxbridge.

Warwick.
Washington.
Wendell.
Wenham.
West Bridgewater.
Westhampton.
Westminster.
West Newbury.
West Stockbridge.
Wilbraham.
Windsor.
Worthington.
Wrentham.

Yarmouth.

Twenty-five (25) towns have made no report. They are s follows :—

Abington.

Barnstable.
Beverly.
Brewster.

Clarksburg.
Concord.

Florida.

Gay Head.
Granby.

Hancock.
Hawley.

Leverett.

Ludlow.

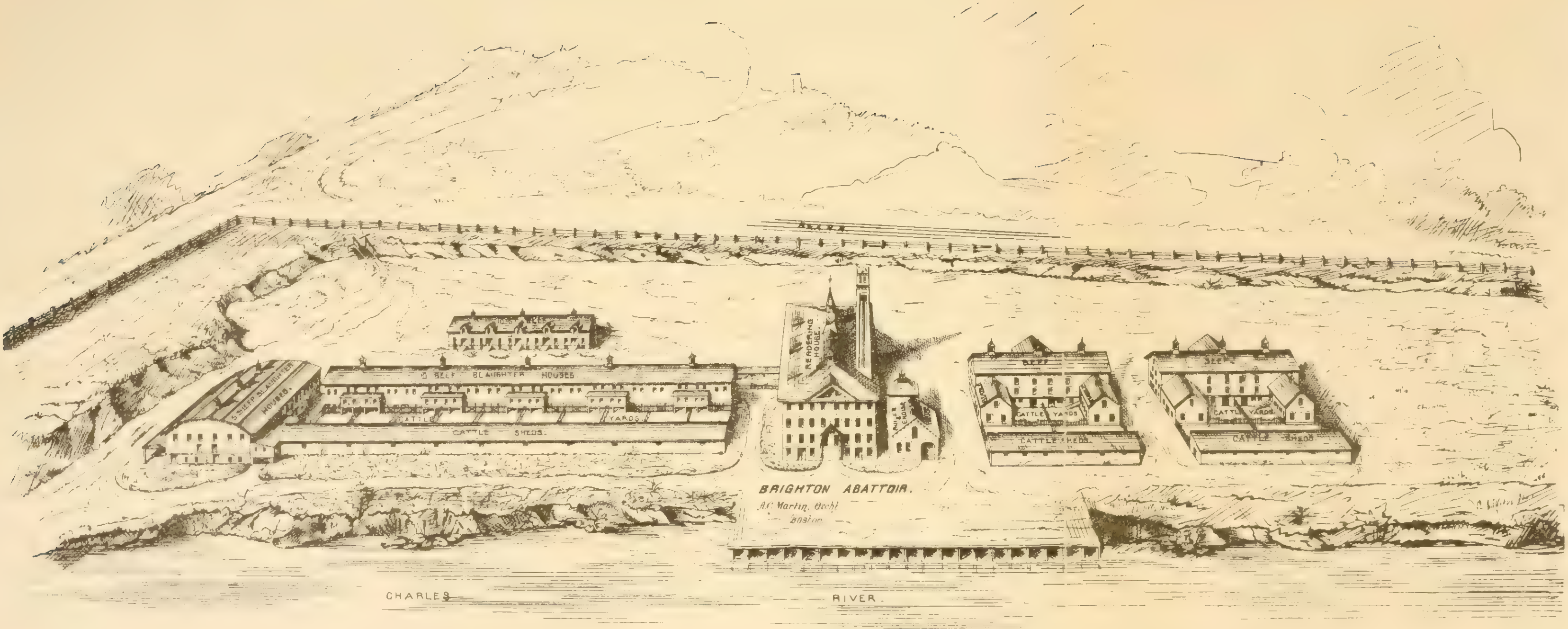
Mount Washington.

Nahant.

Russell.
Rutland.

Savoy.
Shelburne.
Southampton.
Sterling.
Stoughton.

Westford.
Weymouth.
Wilmington.



ABATTOIR OF THE BUTCHERS' SLAUGHTERING AND MELTING ASSOCIATION, BRIGHTON, MASS.

SENATE...... P. D. #34 ......~~No.~~ 100.

FIFTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

JANUARY, 1874.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
CORNER OF MILK AND FEDERAL STREETS.
1874.

MEMBERS OF THE BOARD.

H. I. BOWDITCH, of Boston, *Chairman.*

J. C. HOADLEY, of Lawrence.

DAVID L. WEBSTER, of Boston.

RICHARD FROTHINGHAM, of Boston.

R. T. DAVIS, of Fall River.

T. B. NEWHALL, of Lynn.

GEORGE DERBY, of Boston, *Secretary.*

CONTENTS.

ALPHABETICAL INDEX.

NOTE.

It is stated in the General Report of the Board, page 18 of the present volume, that the three great establishments for slaughtering swine in the Miller's River district have all been enlarged since the passage of the law of April, 1871, concerning "noxious and offensive trades," notwithstanding the power given to the boards of health of cities and towns, by this law, to prevent such enlargement; and that the working capacity of these slaughter-houses has been more than doubled, "without permission and without remonstrance," from the cities of Cambridge and Somerville.

This statement was made only after receiving, in reply to letters of inquiry, written assurance from the clerks of those cities that no action had been taken with reference to the three establishments in question, under the law of 1871.

It appears, however, from a communication received February 14, 1874, from the city clerk of Somerville, that the words "without remonstrance" are not correct in so far as Somerville is concerned. A second and more careful examination of the records of the city of Somerville was made by the city clerk, who states that a petition to enlarge their works was received from North, Meriam & Co., June 1, 1872; that this petition was referred to the committee on health, who reported adversely, and that their report was accepted. A temporary injunction was subsequently obtained from the supreme judicial court by the health authorities of Somerville. This injunction was dissolved by order of the court, August 2, 1872.

It thus appears that the city of Somerville did make earnest, although ineffectual, efforts to prevent the enlargement of one of their swine-slaughtering establishments in the summer of 1872.

The second letter of the city clerk of Somerville was received by the State Board of Health while this volume was in press, and after the printing of the General Report of the Board, but while there was yet opportunity to make this statement in this place.

Commonwealth of Massachusetts.

STATE BOARD OF HEALTH, BOSTON, January 20, 1874.

HON. GEORGE B. LORING, *President of the Senate of Massachusetts.*

SIR :—I have the honor to present to the legislature the Fifth Annual Report of the State Board of Health of Massachusetts.

Very respectfully,
Your obedient servant,

GEORGE DERBY, M. D.,
Secretary of the State Board of Health.

GENERAL REPORT OF THE BOARD.

To the Honorable the Senate and House of Representatives of Massachusetts.

The State Board of Health herewith presents its Fifth Annual Report.

Small-Pox.

One year ago, when the Fourth Report of this Board was presented to the legislature, we were in the midst of an epidemic of small-pox of extraordinary intensity. The disease had existed during the previous year (1872) in two-thirds of all the cities and towns of Massachusetts, and was then present in most of them. Small-pox had invaded Europe and America, as it had not done before during the present century, and very few communities had entirely escaped its ravages. Wherever the spark of contagion fell upon the unvaccinated or upon those who were only partially under the influence of previous vaccination, there it seemed ready to kindle the fires of unmodified or modified small-pox.

The deaths from this cause numbered one thousand and twenty-nine in 1872, which is equal to 70.58 to each 100,000 of population by the census of 1870. The mortality from small-pox in Massachusetts in 1873 is not yet known through the registration returns, but the general course of the epidemic is quite evident from the returns of deaths from all causes made to this Board every week by the clerks and registrars of the largest cities and towns. From these returns, which represent the deaths in about one-third of the whole population, it would appear that the greatest mortality from small-pox was in the winter of 1872–3, and that the disease continued to be very widely diffused, and very virulent and fatal in

January, February and March. It is probable that as many deaths occurred from small-pox in these three months as in the twelve months of 1872. But from about the first of April a rapid subsidence of the disease was apparent, and after the first of June the general epidemic may be said to have ceased. In certain towns it is known to have lingered for several subsequent months; notably in Holyoke, where it prevailed, chiefly among the children of French Canadians and Irish, until September.

From September 6th to the close of the year, not a single death from small-pox has been reported to us from the cities of the State. Judging from the present immunity of London, Paris, New York, Philadelphia and other great cities which suffered severely in their turn, it is not unreasonable to suppose that we may be spared another such experience for some time to come, and possibly for a very long term of years.

The peculiar disposition to receive the disease, the liability to take it which, in utter ignorance of real causes and observing only its effects, the medical profession calls the "epidemic influence" may recur again next year or may be postponed for half a century, but if it comes in the present generation it will find the people better vaccinated than ever before. The protective power of vaccine has been proved beyond all question, and the absolute need of *careful vaccination* is equally evident. The requirement of re-vaccination at least once after mature life is reached is also very generally admitted.

It is our duty to call attention to a special report on small-pox in the town of Spencer in the present volume under the head of "Health of Towns." A terrible mistake seems to have been made by a member of the medical profession.

The circumstances attending the death of one of the victims were the subject of inquiry before the grand jury and no bill of indictment was found, but we think the evidence presented by our reporter is enough to convince the reader that small-pox was directly propagated.

We regret to put on record this shocking occurrence, but if it teaches caution in dealing with virulent poisons, and the utmost circumspection in the practice of vaccination, this

public statement may be productive of increased safety to the community.

The efficient action of the board of health (the selectmen) of Spencer in the exigency they were called to meet is worthy of all praise.

Asiatic Cholera.

As soon as it became certain, in June last, through our correspondence with the health authorities of cities in the Southwest, that cholera was prevailing within the United States, the following letter was sent to the board of health of every city and town of Massachusetts and was also published in the daily newspapers of Boston:—

To the Health Authorities of the Cities and Towns of Massachusetts:—

At a meeting of the State Board of Health, held on the 11th instant, the undersigned were authorized to issue a circular concerning Asiatic cholera, whenever circumstances should seem to require it. Information has been received from trustworthy sources that a disease presenting all the usual signs of cholera is now prevailing at several points in the Mississippi Valley. We may, therefore, not unreasonably expect it to appear in Massachusetts during the present summer. Experience has proved that Asiatic cholera is fostered by filth, and repelled by cleanliness. All measures which secure to a community purity of air and of water, tend not only to prevent the appearance of this scourge, but to diminish the mortality from other diseases which are always present during the summer and autumn. We would, therefore, advise the health authorities throughout the State to prepare without delay, to meet this unusual danger by removing all accumulations of decaying matter in privies, cesspools, drains, cellars, yards and streets, by the free use of copperas or other equally effective disinfectants in vaults and drains; by guarding all sources of water-supply from defilement, even in the most remote degree, by human excrement; by removing the occupants of cellars, and by giving to the whole population the enjoyment of such safeguards for health as they are powerless to secure except by public authority.

There is no cause for any interruption to the usual occupation or diet of the people, or for any public alarm, but every reason for increased vigilance on the part of the boards of health of cities and towns to see that epidemic cholera shall find no foothold within the territory under their charge.

In behalf of the State Board of Health,

(Signed,) Henry I. Bowditch, M.D.
George Derby, M.D.

Boston, June 20, 1873.

Happily the disease did not reach our borders. It is not known to have passed east of the Alleghanies. Whether it will re-appear with the summer heats remains to be seen, but

it will be quite in accordance with the previous history of this epidemic if it should revive in the Western cities and reach us in the present year. The duty of removing every form of filth from within and about our dwellings, which should always be kept in mind by boards of health, becomes, in view of the very possible re-appearance of cholera, more imperative than ever.

Excavations in Clay Lands.

The attention of the Board has been called by the selectmen of the town of Medford to certain excavations which have been made in clay lands for the manufacture of bricks. These have been visited and the following facts observed: On the grounds of the Massachusetts Brick Company there are pits, covering many acres, from which the clay has been removed to a depth of forty feet. These pits are full of water, and steam-pumps are required to free them so that the work of excavation may still proceed. The bottom of these pits is apparently below the level of Mystic River and tide-water. On the territory occupied by the Bay State Brick Company a similar state of things was found. Excavations of very great extent may here be seen extending over an area of from ten to twenty acres, and of a depth of at least thirty feet, and partially filled with water, which is held securely by the clay. The bottom of these pits is apparently below the level of the tide, and consequently undrainable by gravitation. There are other and similar excavations in Medford and other towns where bricks are made. Some of them were made long ago; the surface is now covered with grass, and buildings have in some instances already been put on these treacherous holes.

We believe this subject is one eminently worthy of legislation in the interest of life and health. The present danger is very considerable, from the liability of persons not aware of the existence of these holes walking into them in the night-time and perishing miserably. We are informed that lives are thus sacrificed every year in Medford. But this immediate and present danger is insignificant in comparison with the certainty that whoever shall occupy dwellings in a sunken territory, whose soil is clay, will sicken and die. If anything

is proved in sanitary science, it is the unfitness of an undrainable clayey soil for human residence. These lands are within four miles of the state house; a dense population is destined to press upon their immediate neighborhood within a few years, and unless their occupation for dwellings is in some way made impossible, we shall soon see a needless sacrifice of health and of life.

We would suggest that the owners of such sunken lands, whether excavated by themselves or their predecessors, should be compelled to raise them to a grade which will permit them to be thoroughly drained before using them, or permitting their use for the erection of dwellings.

Sewerage of the Metropolitan District.

It is our duty to again call the attention of the legislature to the urgent need of a comprehensive plan for the sewerage of the whole metropolitan district. The various municipalities bordering upon the Mystic, Charles, and Neponset rivers have each their separate plans of discharging sewage into the streams and estuaries which meet the ocean at Boston, and the result of this complicated and inharmonious system is greatly endangering public health. We regard this question of drainage for Boston and its immediate surroundings as of an importance which there is no fear of overstating. The death-rate of the city proper has for several years been so high as to occasion the most serious concern, and in looking for its causes none are more probable than the imperfect discharge of liquid waste from our sewers and the rapidly increasing foulness of the shallow estuaries into which they open.

The whole subject is in need of immediate investigation by competent engineers.

The Law Concerning "Slaughter-Houses and Noxious and Offensive Trades."

The great powers which were committed to the Board under this law by the legislature of 1871, have been exercised during the past year in several instances, as follows:—

1. Samuel F. Woodbridge, of North Cambridge, beef-slaughtering. (Ordered to "cease and desist.")

2. Horatio Locke, of North Cambridge, beef-slaughtering. (Ordered to "cease and desist.")
3. Frank Goldrop, of North Cambridge, bone-boiling. (Ordered to "cease and desist.")
4. Ransom C. Taylor, of Worcester, bone-boiling. (Ordered to "cease and desist.")
5. Horace P. Holt of Andover, slaughtering. (Ordered to "cease and desist,")
6. R. N. Anderson, of Worcester, copperas factory. (Case dismissed, owing to defects in the petition.)
7. N. Ward & Co., of Boston, bone-boiling. (By mutual agreement between the petitioners, the Boston Board of Health, and Messrs. N. Ward & Co., this hearing was postponed, in order that the sanitary management of the works at Spectacle Island should be committed to the Boston Board of Health.)
8. J. P. Squire & Co., Cambridge and Somerville, hog-slaughtering and rendering. (No decision in this case has yet been made by the Board.)

The law of 1871 concerning noxious and offensive trades, chapter 167, General Statutes, has now been in operation nearly three years, and it may be expected that we should report to the legislature concerning its effects, in so far as we are able to trace them. The law in question was passed without consultation with this Board or any of its members. The general intent seems to have been to give to local boards of health in towns and cities of more than four thousand inhabitants, complete control of premises occupied for noxious and offensive trades; these can neither be built nor enlarged without the written consent of the mayor and aldermen, or the selectmen. The complete management of such establishments is secured by this form of license. But when from any cause this direct control by the local health authorities is found to be insufficient to secure freedom from offence, application may be made by any parties aggrieved to this Board, who are given authority, after a hearing, to order the closure of the offending establishments, and the supreme judicial court is charged with the duty of enforcing these orders, if need be.

One effect of this law is to put all persons carrying on these trades in towns of over four thousand inhabitants on their guard against the orders of our Board; they are more careful to avoid offence to their neighbors, and there has been seen in all parts of the State a readiness to acknowledge that such trades must be conducted with more care than formerly. Another effect has been the establishment of the abattoir for cattle and sheep at Brighton.

One of the parties ordered to "cease and desist" from prosecuting his business, has recently appealed to the supreme judicial court to test the constitutionality of the law, and it is hoped by the Board that this question, which has been constantly referred to by the various counsel for the defendants, may soon be settled.

It seems proper that we should refer to the expenditure of time which is required from members of our Board by the operation of this statute. In the last case brought before us, the hearing occupied fourteen days.

Such a gift of time to the service of the Commonwealth by those who are occupied with private business, often of the most pressing character, can hardly be reasonably expected, and it has been thought that so severe a tax would render probable the resignation of some at least of our members.

The Miller's River District in Cambridge and Somerville.

The sanitary condition of this district has been often referred to in previous reports of this Board, and has been the subject of special legislation during the past three years.

We are charged in the Act establishing the Board, with the duty of investigating "the effects of localities and employments on the public health," and of making "inquiries concerning the causes of disease."

We know of no territory of equal extent within the borders of Massachusetts in so foul and so dangerous a condition, and none in which certain virulent forms of epidemic disease, if once introduced, would be likely to commit such ravages as in the Miller's River District and its immediate surroundings. Asiatic cholera was prevailing in our South-western States during the past summer and autumn. Possibly it is now

latent in that section, and if so, it will be very likely to reappear in the summer of the present year, and to extend to New York and Massachusetts. In these circumstances it becomes our duty to point out the special dangers which are recognized as existing in this Miller's River District, situated within two miles of the state house, and in the midst of a dense population.

During the past year the various forms of nuisance comprised within the Miller's River basin have been more noxious and offensive than at any previous time, and have been very freely discussed in the city councils of Cambridge, Somerville, Charlestown and Boston, in the public press, by meetings of citizens, by very numerous applications to the members of our Board living in Boston and Charlestown, and finally by formal complaints presented to the Board against nine different establishments engaged in what the law recognizes as "noxious and offensive trades." The first application to the State Board of Health for relief from the nuisances of this district, was made in July, 1871, by the boards of health of the city of Cambridge and the town of Somerville. They declared that certain establishments occupied by North, Meriam & Co., J. P. Squire & Co., L. F. Merrill and Joseph Boynton, were noxious and offensive, and called upon us to close them under the law of April, 1871. A Hearing was at once ordered, but at the time appointed the petitioners formally withdrew their complaints against all the parties except L. F. Merrill.

In 1872 an Act was passed by the legislature for the abatement of a nuisance in the lower basin of Miller's River and for the preservation of health in the cities of Cambridge and Somerville, and a joint commission, consisting of the Board of Harbor Commissioners and the State Board of Health, were charged with the duty of devising a plan for draining the territory and abating the nuisance, to be reported to the mayors and aldermen of Cambridge and Somerville.

The report of this commission, as stated in our fourth annual report, was confined to the condition of the basins of Miller's River. These were in a most filthy state by reason of the accumulation of sewage, most of which had been cast into them from the swine-slaughtering establish-

ments on their banks. The remedies proposed were, in general terms, to fill up all the basins with gravel in a certain way and to build sewers which would prevent the fouling of this territory in the future, and the commission stated in conclusion, that "it will then remain to enforce those sanitary principles which the Commonwealth has already adopted with reference to the class of industries peculiar to this neighborhood." The recommendations of the commission were adopted, with certain modifications authorized by the legislature as regards the lines of drainage and modes of filling the territory, and with a reservation of a considerable portion of the largest basin, over which an extensive slaughtering, rendering and packing house had already been built.

The question of the fitness of the new lines of drainage for the removal of the refuse of the slaughtering and rendering establishments then existing in the Miller's River basin, or which might hereafter be placed there, was not made the subject of report by the joint commission.

In November and December, 1872, the noxious and offensive odors coming from the trying and rendering of pork and lard in the Miller's River District were the subject of much discussion by the board of aldermen of Cambridge.

June 24th, 1873, the following petition was received by the State Board of Health from the board of mayor and aldermen of the city of Charlestown:—

CITY OF CHARLESTOWN, June 24th, 1873.

TO GEORGE DERBY, M. D., *Secretary of the State Board of Health.*

SIR:—At a meeting of the board of mayor and aldermen held on the 23d inst., it was ordered that the following petition be sent to the State Board of Health for their immediate action, viz.:

To the Honorable the State Board of Health of Massachusetts.

GENTLEMEN:—Whereas, there are certain slaughtering, tallow-rendering and bone-boiling establishments on the borders of Miller's River in Cambridge and Somerville, that emit and send forth in the night a disagreeable and sickening odor, pervading and filling the air to the extent that the people living on the westerly portion of the city are made sick from inhaling it and are unable to sleep at night; and

Whereas, it is very injurious to health, happiness, comfort and property, we therefore pray your Honorable Board, to take such action as the circumstances demand, believing it is one of those cases where the State Board of Health should take action, the cause of the nuisance being located in one city, and sending forth and emitting its odors to penetrate the surrounding

cities and towns, and we hope no time will be lost in using all the means in your power to abate the nuisance.

I am very respectfully, your obedient servant,

(Signed) JOHN T. PRIEST, *City Clerk.*

On the following day the mayor of Charlestown was visited by the Secretary of this Board, and the following letter was placed in his hands ;—

BOSTON, June 25, 1873.

SIR :—I have just received a petition from the mayor and aldermen of the city of Charlestown, concerning "certain slaughtering, tallow-rendering and bone-boiling establishments on the borders of Miller's River in Cambridge and Somerville."

The State Board of Health derives authority in such cases from chapter 167, Acts of 1871. On the passage of this law, the Board was advised by the attorney-general to act only upon definite complaints, which must be against specified parties, and supported by evidence produced by the complainants.

Whenever a complaint is received by the State Board of Health, against an establishment, the parties in interest are notified, and a hearing is had at the state house without delay. I have therefore to request, that the complaint of the city of Charlestown may be made so definite, that a hearing may be ordered at once as the law requires.

In behalf of the State Board of Health,

Very respectfully yours,

GEORGE DERBY, M. D., *Secretary.*

J. T. PRIEST, Esq., *City Clerk of Charlestown.*

In July 1873 the board of aldermen of Cambridge passed the following order, by a vote of 8 to 1 :—

Ordered, That this board, as a board of health, petition the State Board of Health to abate the nuisances in the 3d ward and its vicinity, and that the city solicitor be directed to appear and represent the city.

In accordance with this order, the city solicitor of Cambridge prepared petitions against the principal swine-slaughtering and rendering establishments, but the aldermen of Cambridge then refused to adopt them.

On the 25th of August, 1873, the following report was made by the board of health of the city of Somerville, to the board of mayor and aldermen :—

(Copy.)

The Committee on Health ask leave to report that during the summer thus far, the nuisance in and about Miller's River and its basins has seemed

to be more offensive than during any previous summer. Complaints have been made by citizens living in that vicinity who are highly respected, in whose word entire confidence may with safety be placed, that on several occasions during the night-time an intolerable stench has invaded their homes, causing immediate sickness in their families. In view of these statements which your Committee regard as truthful, they recommend that the board of health of the city of Somerville, immediately petition the State Board of Health to visit the establishments of John P. Squire & Co., C. H. North & Co., the Boynton Packing Co., the packing-house of Lincoln and Chamberlain, the slaughter-house of J. O'Brien and the rendering establishment of Chas. O'Neill, and that said State Board of Health will take such action as in the judgment of that honorable body, will result in abating the nuisance caused by these slaughtering, packing and rendering establishments.

This report was adopted, and the following petition was sent to our Board by the city authorities of Somerville :—

To the Honorable the State Board of Health of the Commonwealth of Massachusetts.

The undersigned, the Board of Health of the city of Somerville, being hereto duly authorized in behalf of said city, in view of the fact that most noxious and offensive odors emanate from the basins of Miller's River and the establishments in its immediate vicinity, and that it would seem that by those skilled in such matters, means could be devised of much diminishing if not wholly abating the evils and nuisance complained of, respectfully petition your honorable Board to visit and inspect the establishment of John P. Squire & Co., in Cambridge and this city of Somerville, and the establishment, in said Somerville, of the Boynton Packing Co., the packing-house of Lincoln & Chamberlain, the slaughter-house of J. O'Brien, the rendering establishment of Charles O'Neill, and the establishment of Charles H. North & Co., and that your Board will take such action as, in its judgment, will be most for the interests of the public.

THE BOARD OF HEALTH OF THE CITY OF SOMERVILLE,
By the Committee on Health.

[Signed by the mayor, eight aldermen and twelve councilmen.]

The following reply was made by this Board to the foregoing petition :—

GENTLEMEN :—Your communication to the State Board of Health in relation to the establishment of John P. Squire & Co., in Cambridge and Somerville, and the establishments, in Somerville, of the Boynton Packing Co., the packing-house of Lincoln & Chamberlain, the slaughter-house of J. O'Brien, the rendering establishment of Charles O'Neill, and the establishment of Charles H. North & Co., was duly received on the 11th instant, and was presented on the following day at a meeting of the Board.

You request the Board to "visit and inspect those establishments, and to take such action as, in its judgment, will be most for the interest of the public."

Upon proper application and proofs, this Board will exercise its full au-

thority over any or all of these establishments engaged in what are known as noxious and offensive trades, but this authority is derived from the statute of 1871, chapter 167, and is limited by the terms of the statute. By the second section of that chapter, this Board has the power, if, in their judgment, the public health or the public comfort and convenience shall require, to order any person or corporation carrying on any noxious or offensive trade in any town or city of more than 4,000 inhabitants, to desist and cease from carrying on such trades in such places; and such order, if not obeyed by the person or corporation against whom it is issued, may be enforced by the supreme judicial court. But it is specially provided by the statute that on any application to said Board to exercise the powers in this section conferred upon them, a time and place for hearing the parties shall be assigned by said Board, and due notice thereof given to the party against whom the application is made, and the order before provided shall only be issued after such notice and hearing.

You do not ask the Board to exercise the powers conferred upon it by this statute, but say that it would seem that by those skilled in such matters, means could be devised of much diminishing, if not wholly abating, the evils and nuisances complained of. This Board might, as you request, visit and inspect the establishments named, but it would have no power whatever to enforce any directions or recommendations it might give to the offending parties.

The Board has no legal authority to direct in what manner or in what places, parties shall carry on their business.

Responsibility for the manner in which trades known as noxious or offensive are carried on, does not rest with the State Board of Health. Those engaged in such trades can insure themselves against our orders by so conducting their business that it shall not interfere with the public health, comfort or convenience.

If not noxious or offensive, the State Board of Health has no power to interrupt them. If noxious or offensive, they are liable to be ordered to cease and desist.

This Board is always ready to give information and advice to whoever may ask it, but they know of no apparatus or method the use of which will insure the absence of offensive odors. The success of all such plans depends on the intelligence and skill with which they are managed.

In view of the very general complaints during the summer of 1872, and of the great importance of the business carried on at East Cambridge and Somerville, not only to its proprietors, but to the surrounding population and to the commerce of the State, a special visit was made on the 13th of June last, by order of the Board, to the largest establishments on Miller's River, and the great importance of avoiding all offence during the present summer to the people of the neighboring cities and towns was stated by the Secretary. The Board could do no more than this at the present time.

It would seem, therefore, to be useless to again visit and inspect these places with a view merely of giving directions or advice as to the manner in which the business therein shall be hereafter conducted.

The unauthorized and voluntary interference of the Board would, in our judgment, be wholly unavailing toward the accomplishment of the object you have in view.

But if you will present applications for the exercise of our legitimate authority over the offending parties, we will, as in the case of all similar appli-

cations which have been received, order an early hearing in conformity with the statute, and will take such action thereon as the case will justify.

In behalf of the State Board of Health,
Very respectfully yours,

(Signed,) GEORGE DERBY, *Secretary.*

BOSTON, September 17, 1873.

To all parties, whether official bodies or individuals, the same statement has been made during the past summer, viz.: that no action could be taken by our Board until definite charges were made against definite establishments, when a hearing would be ordered without delay.

In September this form of complaint was adopted by a committee of citizens of East Cambridge, and the Board was asked to close the establishments of the following named parties:—

J. P. Squire & Co.;
Charles H. North & Co.;
The Boynton Packing Co.;
Lincoln, Chamberlain & Co.;
Thomas Spellman;
William Reardon;
Charles O'Neill;
Terence Shevlin;
Garrett Barry.

Immediately after the receipt of these petitions the Board held a meeting, when it was thought best, before proceeding with the hearings, to ask all the parties complained of to meet the Board at the state house. This meeting was held on the 1st of October, 1873, when the following address was made to those present:—

GENTLEMEN:—The circumstances under which we have asked you to be present at our meeting to-day are as follows:—

Nine petitions concerning your establishments engaged in slaughtering and packing hogs and melting fats in the vicinity of Miller's River, in East Cambridge and Somerville, were presented to us on the 25th of September, 1873.

The petitioners declare themselves prepared to show that these establishments are noxious and offensive, and call upon us to close them.

The law of 1871, chapter 167, General Statutes, makes it our imperative duty to order you to cease and desist from pursuing your business if these charges are proved.

It is notorious that the portions of East Cambridge and Somerville which you occupy are regarded as offensive; that a public nuisance exists in that locality. It is also generally believed that acrid and nauseating vapors coming from the boiling of fats are a chief cause of this nuisance, and that these vapors deprive, at certain times, thousands of persons of their inherent right to the enjoyment of unpolluted air.

These opinions are so prevalent that we see no reason for ignoring them at this time and place.

It is evident that the stoppage of your business, under the law referred to, without provision being made for its continuance in a more favorable location where it could be conducted without offence, would entail great loss upon yourselves, great suffering on thousands of persons who are either directly or indirectly in your employment, and would seriously interfere with the commerce of the port of Boston.

Under somewhat similar circumstances, two years ago, the butchers of cattle and sheep were invited to meet this Board, and the result of the conference was the building of an abattoir where about one-half of the slaughtering and rendering of Brighton is now done without offence to any one, and in which, we believe, will soon be concentrated all the business of that kind in the neighborhood of Boston.

We have now invited you to meet us, together with the complainants, that an opportunity might be given in an informal and friendly way for any propositions which you may desire to make concerning the important interests at stake.

Should you be willing to propose that, within a reasonable time, the business of slaughtering hogs and rendering fats would be transferred by you from the crowded vicinity of Miller's River to some other place where you could have the benefits of ample space, railroad connections, and direct drainage to deep water with strong currents, and where, by concentration, the requirements of public health could be observed, we think a basis might be found for an arrangement satisfactory to all parties and of great advantage to the sanitary and commercial interests of the neighborhood and of the State.

The present meeting will occasion no loss of time in the settlement of these important questions, as in case no conclusion is reached satisfactory to the petitioners, a time will be fixed at once for the opening of the hearings at this place.

The Board then left the room to give opportunity to the parties interested to consult together, but it was quite evident that no arrangement satisfactory to the petitioners, the defendants, and the State Board of Health could be reached.

It only remained to fix a day for the hearings to begin, and this was postponed, at the request of counsel for the defence, until December 1st, 1873. On that day the hearing on complaint against J. P. Squire & Co. was commenced, and this first case was continued during fourteen days, with sessions of the Board varying in length from five to eight hours, the

closing arguments of counsel being heard on the 29th of December.

The Miller's River District in the cities of Cambridge and Somerville s a valley bounded on three sides by highlands. In this valley or basin is collected the rain-fall of about twelve hundred acres. It is elevated but a few feet above tide-water, and in this respect resembles that large part of the whole Metropolitan District which has been reclaimed from the sea. The portions of the basin still unfilled are exceedingly filthy, the mud being charged with animal matter to a degree which can be seen nowhere else, and the water at ebb-tide black with impurity. The paint of the houses throughout the basin shows discoloration by the action of sulphuretted hydrogen.

The filling of this estuary with clean gravel (if done in the manner prescribed by the joint commission, to which the attention of the legislature is earnestly called) will, it is to be hoped, prevent the further disengagement of offensive gases from the mud and water. It is, however, to be apprehended that, in the absence of authoritative inspection, the important point of filling from the shores towards the channel, so as to drive the accumulations of putrid mud into the channel to be removed by dredging may be neglected, in which case the decomposing animal and vegetable matter would be merely covered up to an insufficient depth and may be the cause of serious trouble in the future.

The construction of the sewer to Charles River will afford an outlet for the sewage of the district as good as the outlets provided for the lands of the Commonwealth on the back bay of Boston.

We regret that the first recommendation of the joint commission to lead this sewer to the Mystic estuary rather than to the Charles was not adopted, but this latter course having been determined as best by the legislature, we can only hope that it will be completed at the earliest possible time. We would urge this measure upon the cities of Somerville and Cambridge as one essential to the health and safety of the people of those cities, whatever use may be finally made of the Miller's River basin.

Whether this be occupied for ordinary business purposes, for dwellings, or for noxious and offensive trades, this sewer can in no possible event be dispensed with.

The all-important question remaining to be settled with regard to this basin of Miller's River, is whether it is, or can be, fitted for the prosecution of trades known as "noxious and offensive" without endangering public health and comfort to those who occupy the territory within and around it. The first requisite for such trades in a sanitary view is complete drainage. Can this be furnished by a submerged sewer, 7,000 feet long, from the corner of Milk and Prospect Streets to Craigie's Bridge?

It may be, and probably is, sufficient for ordinary business uses, or for dwellings, but it may well be doubted whether it is adequate to carry away the liquid refuse from the slaughtering of hundreds of thousands of hogs, at all seasons of the year.

It is to be remarked that the slaughtering of swine in the great pork-packing cities of the West is carried on almost exclusively in the months from November to March inclusive, but the season of greatest activity in the swine slaughter-houses of Miller's River is the summer. The business goes on here at all times, but when, during the winter, Chicago, Cincinnati and St. Louis are creating an active demand for live hogs, a smaller number come to the East, and the reverse of this occurs in the summer.

The three great slaughter-houses in the Miller's River district are the only places in the vicinity of Boston, and so far as we know, in Massachusetts, where hogs are killed in large numbers and for exportation, and at these establishments the season of the greatest business activity is the season of the highest temperature. During July and August, and through the summer nights, the work never ceases.

In addition to these three slaughter-houses, where 800,000 swine were killed in 1873, there are now in the Miller's River basin an extensive pork-packing house, and very numerous small establishments where refuse meat is boiled to extract the grease. The odors from all these places, coming from the living swine, the scalding tanks, the boiling of fresh fats, the boiling of dead hogs received by the trains, the boiling of refuse and putrid meats from the markets and restaurants and

dwellings, combine to produce a stench which is perfectly distinguishable from the odor of the mud of the basins, equally perceptible at high and at low tide, and which is carried by the winds to all the neighboring highlands.

The nauseating odors coming from the rendering of both fresh and putrid fats in the Miller's River district are often strong enough to wake persons from sound sleep in Charlestown and Boston, at a distance of two miles from the place of their origin.

As the establishments in which these operations are carried on increased in number and in the extent of their business, the nuisance* has grown more and more intolerable, and unless the offensive odors can be removed or destroyed or prevented the whole basin of Miller's River will soon become a district of chronic nuisance, and a place to be avoided by all residents, like the portion of the city of New York devoted to swine slaughtering, between 39th and 41st Streets, on the North River.

From such evils, which must affect, not only the physical, but the moral health of the people of East Cambridge and Somerville and Charlestown and Boston, we would gladly see them delivered.

The responsibility of the health authorities of Cambridge and Somerville for the present condition of this district cannot be overlooked.

The law of 1871, chapter 167, section 1, gave them authority to control and prevent the extension of all these offensive trades. While the boards of health of both cities have declared the three swine slaughter-houses to be nuisances, and in various ways have expressed the wish that the State Board of Health should abate them, these establishments have all been enlarged, and their capacity for slaughtering and rendering more than doubled since the passage of this law, without permission and without remonstrance.

It is not supposed that the health boards of either of these cities would, during this whole period, have given leave for

* The nuisance of the passage of carts containing putrid blood and offal from one of the swine slaughter-houses of Miller's River through the streets of Everett is the subject of complaint from our correspondent in that town. (See Everett: Health of Towns.)

the establishment of a new slaughter-house, as the people would have protested against it, but they have by their tacit consent to the indefinite enlargement of those already existing, not only added to the nuisance, but given to the proprietors a virtual monopoly of a profitable business.

It is exceedingly improbable that, with the experience of the past year in mind, the citizens of Cambridge and Somerville will in the future allow either the erection of new slaughter-houses, or the further extension of those of J. P. Squire & Co., C. H. North & Co., and the Boynton Packing Co.; yet, if they take this course, they will in so doing directly obstruct the growth of the export trade of Boston, which the members of this Board hope to see indefinitely extended.

The evils connected with this system of swine slaughtering and rendering, as now carried on in the Miller's River basin, are seen to be enormous, and they require a speedy remedy. It is one of those cases in which the interests of public health and of commercial profit at first sight may seem to conflict, yet we think they really do not. Were this business removed to a suitable place, with ample space, direct drainage to strong tidal currents, and buildings planned with special reference to sanitary safety, the slaughtering of swine for exportation might be extended without limit, and without prejudice to public health, comfort or convenience. In the Miller's River basin this extension seems to us impossible: 1st, because it is a valley surrounded by hills, which will soon be completely covered with dwellings; 2d, because the drainage is, and must always be, insufficient for such uses; 3d, because the slaughter-houses were originally built without adequate reference to sanitary requirements.

An efficient remedy for existing evils in the Miller's River district will be found, in our opinion, in the removal of all the bone-boiling and refuse-boiling kettles and tanks in the smaller establishments to some remote place, where they can be brought together, and supervised by the local authorities. This business might all be done, without nuisance of any kind, on one of the islands in Boston Harbor.

The slaughtering of swine, the packing of pork and the rendering of fresh fats, we think, should all be ultimately con-

centrated in an abattoir arranged for that special purpose, and we are confident that in this way it could be conducted in such manner as to avoid all nuisance, and greatly contribute to the growth of the trade of Boston.

Good places for such an establishment might be found near deep water, and with convenient railroad connections.

In furtherance of this plan, we respectfully ask the legislature to pass a general law, authorizing a certain number of persons with a certain amount of capital (the minimum of each to be fixed) to incorporate themselves for the purposes of slaughtering swine, of rendering the fat of swine, and of packing pork, within five miles, in an air-line, ot Faneuil Hall Market, with authority, subject to the approval of the State Board of Health, to purchase or take land, and with similar provisions in relation to the control of the State Board of Health, as are contained in the Act establishing the Butchers' Slaughtering and Melting Association, at Brighton.

The Brighton Abattoir.

Under this head will be found:

1. The annual report to our Board of the President of the Butchers' Slaughtering and Melting Association.
2. Regulations for the business of the abattoir.
3. A description of the abattoir, by the architect, Mr. Martin.
4. A letter from Hon. Jackson S. Schultz, of New York, late Chief Commissioner of the United States at the Vienna Exhibition, describing the European abattoir system, as observed by him during the past year, together with observations on other sanitary subjects, both in America and Europe.

We have reason to feel satisfied with the working of the Brighton abattoir during the six months that it has been in operation. It will be seen that it already furnishes a very large proportion of the meat consumed in Boston and its vicinity. Deducting what is sent here from Maine and the British Provinces, and other distant points, it is probable that one-half of the remaining beef and mutton sold in Boston comes from the premises of the Butchers' Slaughtering and Melting Association. This amount will be largely increased during the coming year.

The difficulties which have attended the establishment of the abattoir are now fairly surmounted, and we may confidently look to its future growth and prosperity, and to a corresponding diminution of the number of slaughter-houses on the old plan. It will take time to abolish these entirely, but the influences already at work must finally lead to that result.

The question whether this business can be conducted without offence we think has already been answered. Since the middle of June, and during the hot months of July, August and September, and up to the present time, the slaughtering of beeves and sheep and calves, the rendering of offal, and the drying of blood and tankings have been going on continuously, and we are not aware of any offensive odor having proceeded from the premises.

To accomplish this result has required constant care, but it has been done, and may be done for an indefinite period in the future.

The price of safety in this respect is *unremitting vigilance*, and especially in the management of the apparatus for destroying the offensive gases by fire during both day and night. Neglect of this precaution for a single hour would be attended with nuisance, but none has to our knowledge yet occurred. The proprietors of the abattoir well understand that this Board is powerless to protect them if, through any neglect, the establishment should ever become a cause of public offence; but there is no reason to expect anything but continued sanitary success, if the above-named precautions are constantly observed.

The letter of Mr. Schultz will be found most interesting and instructive, and contains many hints concerning sanitary affairs which have been suggested by his perfect familiarity with American customs, acquired in the discharge of his duties as president of the Metropolitan Board of Health of New York, and by close observation of those of European countries.

It would appear that if we are inferior to Europeans in some of the details of slaughtering, we can teach them many useful lessons in all that pertains to rendering and drying,—in fact, in all processes which have for their object the avoid-

ance of offensive odors. The letter of Mr. Schultz will also make more evident some of the reasons why animals intended for slaughter are treated with less kindness here than abroad.

We are perfectly aware of the great need of reform in this respect. There is unnecessary cruelty to animals in the United States, from the time they are placed on the railroads for transportation to the Eastern markets, up to the moment of their death. This Board will gladly do whatever may be possible to improve the whole system, but it must be remembered that if in the construction of the abattoir, they had insisted on different methods of killing from those to which the butchers were accustomed, the establishment would not have been built.

The Board think it necessary to repeat the following request, which was made to the legislature of last year, but which was not granted :—

"We respectfully ask the legislature to provide for the appointment of an inspector of animals and meat, at the abattoir of the Butchers' Slaughtering and Melting Association at Brighton, with an adequate salary, to be paid by the State, and that this inspector be under the control of this Board, since we are by the law made responsible for the safe and proper management of the establishment."

Preventive Medicine, and the Physician of the Future.

By Henry I. Bowditch, M. D., Chairman of the Board.

In this paper there is an attempt to anticipate and to describe the effect which will be produced upon the public mind, and upon the relations which the medical profession will hold towards the community, when preventive medicine, now in its infancy, shall have its full power over the public health.

As a partial illustration of the subject the writer attempts to answer the question, "What, according to our present knowledge, should be the measures inaugurated, and how long should these measures be carried out, in order to prevent, so far as is possible, a human being from falling into consumption, into which, by his hereditary tendencies, he may fall, unless the utmost care be taken from birth to beyond middle life to counteract said tendencies?"

On the Present Condition of Certain Rivers of Massachusetts, together with Considerations touching the Water-supply of Towns.

By Wm. Ripley Nichols, Professor of General Chemistry in the Massachusetts Institute of Technology.

This paper presents the results of chemical examinations made at various times during the year 1873, in pursuance of the inquiry begun the previous year, into the present condition of the running streams of the State.

The streams which were selected as the subject of the present investigation are the Merrimack, Blackstone, Charles, Sudbury and Concord. The Merrimack is an example of a stream of very considerable size, on the banks of which are large manufacturing towns; the Blackstone is an example of a stream receiving a large amount of town-sewage besides manufacturing refuse; the Charles and Sudbury are rivers of rather different character, the investigation of whose condition possesses additional interest from the fact that they have been proposed as sources of water-supply for Boston and neighboring cities.

The condition of the water-supply afforded by Lake Cochituate and by Mystic Lake is considered at some length, and attention is called to the danger which threatens these reservoirs from the influx of foul materials. An investigation has also been made of the character of the water supplied to the cities of Waltham and Lowell,—Waltham being supplied from Charles River by means of a filter-basin, and Lowell from the Merrimack by means of a filtering gallery.

Attention is further called to general considerations touching the effect upon the water-courses of the discharge of sewage into them, and to danger arising from "the joint use of water-courses for sewers and as sources of supply for domestic use."

We believe that the information presented by Prof. Nichols will be found to be of great value to the legislature and to the people of the State.

The present condition of some of our chief rivers is here placed on record for future use and comparison.

The Health of the Farmers of Massachusetts.

By J. F. A. Adams, M. D., of Pittsfield.

This is a paper for the farmers to read if they would improve the health and prolong the lives of themselves and of their families. In it are treated many topics, among which may be cited the following: over-labor and worry of the farmers and of their families; the economy of health, compared with the parsimony that begets disease; of the proper site for a homestead, and of the importance of cleanliness around it; of drainage; of pure water; of food; of the earth-closet as an invaluable preventer of disease; and, finally, the whole is supplemented by a witty and wise paper on farm-life by one who knows whereof she writes.

Cerebro-Spinal Meningitis in Massachusetts in 1873.

By J. Baxter Upham, M. D., of Boston.

This document, prepared with great labor by Dr. Upham, presents a view of the prevalence of the disease in Massachusetts during the past year. It rests upon a correspondence with physicians throughout the State, and its deductions are drawn from more than five hundred cases. It is a most valuable record of a terrible disease, and although its special cause seems to be not yet unravelled, the author is able to draw very important deductions as to the necessity not merely for general cleanliness in a town, but on the part of every citizen in regard to many things under his own control.

Hospitals.

By George Derby, M. D., Secretary of the Board.

The object of this paper is to show what influence hospitals may have upon public health, to point out in what respects they have often failed to carry out the benevolent intent of their founders, and to suggest improvements in their construction and management. The plan of building hospitals of a height of only one story is recommended, and chiefly because their ventilation thus becomes simple and manageable. This is the result to which the writer is led by an extensive experience in both civil and military hospitals.

Political Economy of Health.

By Edward Jarvis, M. D., of Dorchester.

The studies of Dr. Jarvis, through a long term of years, enable him to bring to the review of the "Political Economy of Health" a fund of special information and stores of learning which few persons possess. His opinions will have great weight. The subject is one, however, upon which on certain points as wide a difference of judgment may be honestly entertained as in the consideration of questions of finance. The Board presents this paper as one which will be found of great value not only in the expression of the opinions of the author, and in the numerous authorities cited by him in their support, but as bringing up a question of infinite importance, and capable of being viewed in many lights.

School Hygiene.

By Frederick Winsor, M. D., of Winchester, Mass.

This paper contains many points of interest, among which we cite the following:—co-education of the sexes; care to be taken in the education of girls, especially at certain periods; the influences of our high schools on girls; on badly constructed seats and desks as causes of various distortions of the body; on overstudy as influencing eye-sight; study out of school; the influence of appeals to emulation and to vanity and the differences of their effects on boys and girls; on "worry" of teachers and pupils; on school workshops, and very interesting statements on the Half-Time Schools of England; on ventilation and site of school-houses. Dr. Winsor makes also some important suggestions in regard to the propriety of recording the causes of, as well as the facts of, the absences from school.

In the last report of this Board it was earnestly recommended, that every local board of health should have a physician as one of its members. Our special reporter on the Hygiene of Schools recommends that such medical officer should also have charge of the schools in so far as may enable him to prevent the occurrence or the spread of disease, to watch the modes of warming and ventilating school-houses, to observe the wants of the children as regards light, exer-

cise and position, and to give such special advice on these and similar points as may be needful.

The Use of Zinced or Galvanized Iron for the Storage or Conveyance of Drinking-Water.

By W. E. Boardman, M. D., of Boston.

The question of the safety of using zinced iron for the purposes above named has of late been much discussed in Massachusetts.

The fact that such water contained zinc in some form was well known, but whether or no it was harmful was disputed.

Dr. Boardman (having no preconceived ideas on the subject) was requested to obtain all the information possible, and report to the Board. This he has faithfully and carefully done in the accompanying paper. His own conclusions will no doubt be those of many of our readers, but while presenting the evidence, the Board is not prepared to give a positive opinion, or to declare that zinced iron is under all circumstances, and with all persons, harmless.

Duties of Local Boards of Health.

By Azel Ames, M. D., of Wakefield.

This article will afford valuable aid to the boards of health of towns. It describes the powers and duties devolving on such boards, and we recommend its careful perusal by all health officers and town authorities in this Commonwealth.

Health of Towns.

Under this head is presented as much information as we have been able to collect concerning the condition of public health in all parts of the State.

Many interesting letters from our regular correspondents are here given, and many suggestions concerning sanitary affairs, which will be found of general application. The need of efficient health boards in cities and towns is expressed on all sides. It is for the people to apply the remedy.

Special investigations have been made in several towns by direction of this Board, and by physicians skilled in the discovery of the causes of disease.

Attention is called to many instances of disease directly caused by impurities of air and of water, which were entirely removable. It will be seen that "trichina disease" has again been recognized—this time in the town of Becket—and is reported to us by a physician in Lee.

The thanks of the Board are presented to our correspondents for the instructive facts they have reported to us.

We desire to express our thanks to the registrars and city clerks of the most populous places in Massachusetts for their politeness in furnishing the information which has enabled us to make a report of mortality in the "Boston Journal," every Wednesday morning.

All of which is respectfully submitted,

HENRY I. BOWDITCH,
R. T. DAVIS,
RICHARD FROTHINGHAM,
GEORGE DERBY,
DAVID L. WEBSTER,
J. C. HOADLEY,
T. B. NEWHALL,

Members of the State Board of Health of Massachusetts.

Expenses of State Board of Health, 1873.

Postage and stationery,	$536 68
Travelling expenses of Secretary,	301 39
Carriages,	165 30
Printing,	116 02
Soldier messengers,	104 37
Office furniture,	100 57
Clerk hire,	97 92
Express charges,	80 45
Personal expenses of members of the Board,	95 05
Drawings,	75 00
Telegrams,	19 97
Wm. Ripley Nichols, for chemical investigations and report,	1,300 00
Paid for special investigations,—to Edward Jarvis, Arthur H. Nichols, F. W. Draper, J. F. A. Adams, Frederick Winsor, Helen M. Plunkett, J. B. Upham, S. W. Bowles, Azel Ames, Jr., W. E. Boardman,	1,338 68
Miscellaneous expenses,	16 35
	$4,347 75

PREVENTIVE MEDICINE

AND

THE PHYSICIAN OF THE FUTURE.

By HENRY I. BOWDITCH, M. D.,
Chairman of the Board.

PREVENTIVE MEDICINE AND THE PHYSICIAN OF THE FUTURE.

Gentlemen of the State Board of Health.

In my earliest communication with you I endeavored to express in a few words some general views of the great and benign objects presented before us, and the correlative public duties that devolved upon us, by our appointment as members of the State Board of Health. I wished then to give my highest ideal of those objects and duties, and I then expressed my belief that we should not fail of doing some service to the people of Massachusetts if, with simplicity of purpose and single-hearted devotion to that purpose, we should pursue, slowly, perhaps, but steadily, the path opening before us.

It is not my intention now to review what we have already done. I may, however, be allowed to say that the annual liberality of the legislature in regard to our reports, and the fact that the example of Massachusetts has been followed by several States of this Union, who have established similar boards, is certainly gratifying. It would seem that our example has stimulated others to a like course of action in regard to Preventive or State Medicine, as it has been sometimes called, because the improvement of the public health and the prevention of disease among the people is the object of both. This object has now occupied us for five years, and we can, perhaps, see more clearly its tendency and noble scope. We can also, perhaps, prophesy more decidedly than before the beneficial results that will accrue to mankind when the world enters heartily into its objects, and when similar boards have been formed, and have worked for many years in every civilized community.

Preventive or State Medicine is of recent origin. It has been the natural outgrowth of modern thought and resources, stimulated by centuries of suffering and by the sacrifice of

multitudes of human beings. Modern thought, later and more scientific methods of investigation, and more rapid means of communication of thought and of action have given this idea to the nations. It is true that Hygiene, or the science which would promote human health, has been discussed from earliest times, but commonly as applied to the individual man. The scientific study of the laws of disease as they affect large masses of men, and the voluntary efforts of great states to study those laws by means of boards of health, or of experts set apart for this special purpose, are strictly of modern origin. Hippocrates, wise as he was, could not, with the imperfect means of communication in his day, have inaugurated it. Moreover, in the earlier states, man as an individual never stood, in the estimation of his fellows, nor of the government, so high as he does at the present day under European or American civilization. Formerly his welfare was subordinated to that of the state. Now, the theory is exactly the reverse, and the state claims to have the tenderest interest in the welfare of each and every one, the humblest or richest of its citizens. Formerly, all persons believed, as many now believe, that prayer should be offered to the offended gods in order to stop plagues, famine and death. But now, most persons feel that, although prayer may avail much to enable an individual or a state to bear calmly some terrible calamity or to die bravely, if need be, in a great cause, it can never drive away fever, cholera, nor small-pox. It can never cure consumption, though it may help both sufferer and friends to bear it more patiently. To submit quietly to any remediable evil, as if to the will of Providence, is not now considered an act of piety, but an unmanly and really irreligious act. It is the part of error and stupidity which does not believe in the duty of studying into the physical causes of disease, and in at least endeavoring to crush out these originators of pestilence and of death.

Modern Preventive Medicine has been hinted at by Nature from the earliest time. Occasionally she has shown us how she can summarily strangle disease, and drive it forever from its usual haunts. The great fire in London, in 1666, burned up the greater part of that metropolis. With its great sorrows, trials and losses, it brought one of London's greatest

blessings, viz.: the extirpation of the plague which had previously so often ravaged the inhabitants.*

Intermittent fever has ceased in certain parts of Great Britain and of this country under the influence of tillage and drainage of the soil. Till innoculation was brought from the East and taught to modern Europe, the physician could not mitigate small-pox.

Jenner, led by Nature's teachings, substituted the milder disease of vaccination for the fatal scourge of small-pox.

Private investigations in Europe and America have, in these later days, proved that residence on a damp soil brings consumption; and, second, that drainage of wet soil of towns tends to lessen the ravages of that disease.

We have been taught by Murchison and others that fevers are often propagated by contaminated drinking-water or milk. Our own Board investigations have proved that contaminated air may also cause it.

Still more recently cholera has been brought, in its origin and progress, under law, and we know how we could probably prevent it if proper precautions against its origin were taken. A neglect of proper sanitary regulations tends to propagate this scourge, year after year, over Europe.

These monitions given by Nature and individuals as to our power of checking or preventing disease, have at last culminated in the fact that the State decides to use its moral power and material resources in aid of State or Preventive Medicine. England, in this respect, outranks all other countries. America, I think, stands next.

This appears to me the general course of events hitherto in regard to public health. I do not mean to assert, however, that nothing has ever been done before by the state. On the contrary, the Parliament of Great Britain and other European states and the legislatures of our various States have at times spasmodically and tentatively, for centuries past, given powers to local town boards of health. They have, moreover, at times, devised important plans for the health of the people and for the prevention of the spread of certain diseases. But all these were trivial compared with the present

* 68,596 died of it in London, 1664–5.

position of England and of some States of this Union where state boards of health have been established.

Again, physicians have heretofore devoted themselves chiefly *not to the prevention*, but to the "cure" of disease. How utterly impotent have commonly been their efforts to cope with great epidemics! The giving of medicine during a disease, not the prevention of it, has been their chief aim, and the community now generally believes that the physician is simply an administrator of drugs. How rarely is a physician called upon to mark out the course a man should pursue to prevent their use. Nevertheless, modern times will bear ample witness to the zeal with which some of the most distinguished of our number have protested against the too free use of medicine, and have declared that our art must be pursued more in accordance with Nature's laws, and not in total neglect of them, as was too frequently the case in former days. Some few even, though I would protest against it, have carried their skepticism so far as to lead one to believe that they think the practice of Physic hitherto has been an unmitigated evil.

With one accord I believe it may be said that the whole profession has cordially greeted the advent of State or Preventive Medicine. What, it may now be asked, will be the effect upon the public and the profession after two or three centuries of growth of the principles of Preventive Medicine? I look forward with high hopes for the future of this young idea, founded as it is on the duty of the state to investigate the laws of all diseases so that, as far as possible, all shall hereafter be prevented. I think that idea cannot fail of making a stalwart growth. It may make many errors, but it must make yearly progress in the knowledge of the more hidden causes of disease. At least three good results will arise from it:—

1st. The profession will learn that a system of therapeutics dependent on materia medica simply, is much less valuable than that which seeks to defend its patients from the insidious approaches of the causes of disease.

2d. The people will themselves learn to avoid many evils into which they now fall, because of their ignorance of the laws of health. They will have less faith in drugs, more in na-

ture; more in anticipating and preventing evil than in curing it after it has begun.

3d. The knowledge of the precise effects of special drugs, and of their various compounds one with another, will become more and more accurate under the teaching of modern experimental physiology, and still more under clinical experience. Though it may take centuries to develop, even to a small extent, the future materia medica, the future physician will use each article with a finer knowledge of the precise effects of each drug and of its combinations, than it is possible for us now to have. We can scarcely foresee the time that will be required for this materia medica to become even tolerably perfect. In fact, the knowledge of the special action of drugs at the present day, compared with what we have yet to learn upon this important subject, is a mere trifle.

Meanwhile, as the profession of medicine becomes more thoroughly scientific, the people will also gradually learn that all filth (physical, moral or intellectual) is absolute poison; that no violation of physical, moral or intellectual law can be made, even momentarily, without injury to human comfort and life, and possibly without causing premature death. It will learn that it is not only worse than useless, but a vile wrong to one's self, to use various articles as incautiously as they are generally now used.

But it may be asked, What is to become of the physician and his practice, when the public takes care of its own health more than it does at present? Will the profession be useless? Far from it. It will stand higher than ever. It will be the prophet of the future, and will direct men how to govern their own bodies in order to get the full amount of work and of joy that is possible out of each body that appears in life. I feel sure that more than at the present day will the wise adviser and practitioner of medicine be then needed, whenever misfortune or wilfulness or carelessness, folly or crime shall have brought disease and perhaps a tendency to early death into a family. It will be the physician's duty to show the way out of such impending evil. He will take the child at its birth, and will cast its horoscope from the past and present of its family tendencies, and its actual surroundings. Having well considered

these data he will lay down the rules of life which should rigidly be pursued by parents and by himself in order to gain possession of as much of perfect health as he is capable of having. As the dentist now undertakes to modify and to guide the various processes of dentition from earliest childhood to old age, so the physician will be the monitor and guide for the entire body from birth to death. The dentist is, philosophically speaking, in advance of the physician of the present day, inasmuch as in his own specialty he oftener acts on the principle of Preventive Medicine. It must be admitted, moreover, that however wise a prophet the physician may be, and however skilled in hygienic law the people may become, there will always be a very wide margin of ignorance, folly and of adverse circumstances on the part of the public, which must be met, and, if possible, remedied by the professors of our art.

To be able to aid in inaugurating such a future state of professional and lay knowledge is surely an object worthy of our highest effort. It is satisfactory to me, and I hope also to you, to think that we are allowed to advocate this noble cause in Massachusetts. It is my hope that by the efforts of the Board the State will annually become more alive to its best interests, and to its duties towards the people. Hygienic laws will be enacted and they will be obeyed by the many, if from no other motive, from self-interest. May we not hope that our country homes will be more carefully guarded from the many causes of disease that now, through ignorance, beset them. I trust that in our cities large tenements for the poor, in which there are common corridors and water-closets or privies for two or three hundred people, and in which the comforts of home and all the amenities of human life are set at naught, in which it is impossible to educate a family in decency, and where disease and crime prevail, will be declared public nuisances and pest-houses. I look forward to the time when a city government will be considered criminal which, like the city of Boston, allows, year after year, sewers to be introduced as unwisely as they are at present, and its sewage to be thrown broadcast about its borders, thereby at times overwhelming its inhabitants with a tainted atmosphere. The same govern-

ment will, I trust, feel the importance of having proper administration of the laws about drunkenness, guarding itself alike against the futile waste of time of attempting to enforce a general prohibition, or the allowing, as at present, of unbridled license in the sale of liquor. When Preventive Medicine has full sway, men will not be allowed day after day to disturb the public peace or the comfort of their own families by beastly drunkenness. The authorities of that day will promptly decide whether it be the result of disease or of crime, and will seclude the wrong-doer either in a drunkard's sanitarium or a prison. I feel sure, moreover, that the time will come when the selling of rum to an avowed and well-known drunkard will be deemed one of the most dreadful of crimes, inasmuch as drunkenness strikes at the root of the physical, moral and intellectual health of the people. These are only a few of the blessings that will arise when Preventive Medicine shall have its full sway over our people, and when individuals and laws shall have been gradually moulded by it.

As an example, imperfect though it must be, of what I think will be the relations of physicians and the community compared with those which they respectively hold at present, let me imagine the following: Suppose two parents have hereditary tendencies to consumption, and they are desirous of knowing how best to manage their child that has just been born. They wish that it may have the best chance of arriving at a good old age after a life of health. Let us suppose that both parents have this ancestral tendency to that disease of the lungs which is known as consumption. According to some modern writers, it has many antecedents or causes, but we shall probably know it for centuries to come, as it has been known in the past, as the one disease of the lungs that slays a large percentage of all who die in New England. There are certainly some general topics, even with our present knowledge of its antecedents, which would naturally and physiologically come under discussion in replying to the inquiries. Among them are some which are generally applicable to all human beings, whether in health or disease, viz.: *residence*, *nutrition*, *clothing*, *care of the skin*, *bathing*, *&c.*,

recreations, education, profession, exercise, walking, running, dancing, horseback exercise, driving, gymnastics, bowling, rowing, swimming. Let me try to give most briefly some general ideas on each of these topics.

Residence.

The physician must look well to the homestead,—its situation, its surroundings, its construction. He must declare that the house should be in the country rather than on the sea-coast, and placed on a dry soil, or if situated on a wet soil, that it must be immediately and effectually subdrained in all the immediate vicinity, and the cellar must be cemented so as to be *always dry.* All draining, in fact, around and from the house must be arranged with the greatest care; for manifold evils may fall on a family when little attention is paid to this important matter. Especially should all refuse-matter from the kitchen and other sinks, from water-closet or privies, be effectually carried away, and at the same time be so far removed from the source of water-supply which is to be used for culinary purposes, that it will be impossible, by any percolation through the soil, that the one should mingle with the other. To avoid this contingency, closely cemented stone, brick or vitrified tile-drains should be used for the refuse-water, and the supply for culinary purposes should be drawn, if possible, from some distant spring or pond, and be conveyed to the house in wooden, iron or brass, and if possible, not lead pipes. In future times, when Preventive Medicine has gained its full and legitimate influence over the community, no city, town or large village will dare to carry on its government without taking immediate measures to procure an abundance of good, pure, soft water, and the same authority will carefully * watch to prevent all possible contaminations from houses or mills or other impurities. Having chosen a proper site for the house, and having carefully drained it and supplied it with pure drinking-water, arrangements should be made for an equally abundant supply at all

* In this connection I would refer the reader to the Report by W. R. Nichols, in another part of this volume, on the "Present Condition of Certain Rivers of Massachusetts."

times, day and night, of pure air. For this purpose it will be well to have the house situated on an elevated knoll, and open to the south and west winds, though shielded, perhaps, somewhat from the north and east. It should not be too much shaded by trees or creeping vines, for these cause a dampness about it. The sun, which modern science would prove is the source of all vegetable and animal life and activity, and whose beneficial rays are daily felt when they are present, or sighed for when absent, should be allowed to have free access, if possible, to every room and chamber in the house. The atmosphere of the family dwelling should never be allowed to be too cold in some parts, or too hot in others. It should be *slightly tempered* with warmth in the dead of winter all over the house. In the sitting-room the heat should not be above 72 Fahrenheit, nor below 68; 70, the medium, is the best. Most people, at the present day, seek to gain this by means of furnaces or radiating steam-pipes in each room. Often not the least arrangement for a proper change of air is made. Nothing can be more deleterious or more absurd than the very common method, much employed now, of building houses without any open fire-places. Some, even, have only small flues, utterly inadequate for the purpose of ventilation. It is the duty of Preventive Medicine to protest against all these, and to endeavor to bring back our builders and the community to common sense in this respect. One general rule should be laid down. Let open fire-places, connected with well-constructed chimneys, be made in every apartment, so that they can be used, if needed, for proper ventilation. In this respect, at least, our fathers were wiser than we, with all our vaunted knowledge. They established their broad hearthstones, and threw up their wide-throated chimneys. Gathered around these the children inhaled healthy, continually renewed, air, and during the long winter evenings, as they watched the blazing log-fire, or listened to the crackling embers, they gained health as well as joy; whereas our children scarcely gain either, while huddling around the black hole of a furnace register. The youth of those days obtained a more genial warmth, as well as this constant change of air, and which cannot possibly be obtained by the modern furnace, or

by that still more pestilent apparatus, born of modern parsimony in the use of pure air, the air-tight stove. This latter contrivance, whether it be constructed to burn wood or coal, or whether made of wrought-iron or cast-iron, must be wholly condemned by Preventive Medicine. It is an instrument of torture at times for an invalid, and if continually used it is fraught with the worst consequences to a growing family. It wholly prevents ventilation, and heats too much. I have a decided belief that a consumptively inclined family may have its whole fate decided adversely by the exclusive use of the furnace, or air-tight, or steam apparatus to warm all the homestead. Patients have told me that my orders for the removal of an air-tight stove, and for the use of an open fire have relieved them more than any drugs which I gave them. They felt grateful because I refused to prescribe unless my orders in this respect were immediately obeyed, *as the first and most important measure to be adopted.*

Open fire-places, or the admirable substitute for that, the old-fashioned but philosophical Franklin fire-place, or open-grated stove or grate should therefore be in every room of the modern dwelling, and thus we should imitate in a degree at least our ancestral homes, and gain all the advantages without the few disadvantages of their ampler chimneys; for these old homes, I think (although I am not quite sure upon this point), failed in one respect, and in which we moderns have probably improved upon ancient modes. They made no arrangement for tempering the atmosphere all over the house. This certainly is a great comfort in modern days, and I cannot think it a detriment if we use small furnaces communicating with the open air, or if we place simply entry stoves so to slightly warm the corridors and chambers during the coldest of the winter weather. Great caution, however, should always be taken when using furnace or entry stoves to provide thorough ventilation by opening the windows daily. Unless the weather be intensely cold, a small crevice may be advantageously left open during the entire night. On this latter point so much depends on individual power and conditions that no general rule can be laid down save this, viz.: that many more die from the want of pure air than from a superabundance of it, even if it be cool.

Nutrition.

Upon a proper nutrition of the body depends the present and future health of any being. It becomes therefore a very important element in our attempt to prevent consumption. It varies much with the age and individual tendencies, each of which will have to be considered by the future physician. In babyhood the mother's milk is usually most fitted for a child, and should always be used unless, according to our hypothesis, any hereditary taint exist. But under the supposition that the mother is born of consumptive parents, what should be done? Shall she nurse her child? If before and after its birth she is *in perfect health*, and has always been so, and is anxiously desirous of nourishing her babe, I should not feel at liberty to prevent her. I would allow her to continue to do so during the usual period of nursing, provided she and her babe continue well. But if the health of either should fail, I should feel compelled to advise the mother to give up this duty to a healthy wet-nurse. I should require this for the sake of both mother and child. For the unfortunate parent who continues nursing may be undermining her own health, at the same time that she brings perhaps death to her child. Some, I know, are willing to forego in such cases the employment of wet-nurses, and substitute instead cow's milk. That this substitute will be often apparently sufficient for the present health of the babe cannot be denied, but I have no belief that we can ever improve upon a healthy woman's milk as the nutriment for a babe. Therefore, when the milk of a healthy nurse can be procured, that is at least tolerably near the age of the child, it will usually prove better than any artificial substitute. When a wet-nurse cannot be got, then condensed milk may be used, largely diluted. But a long time before the mother's milk or its artificial substitute be given up as the main article of diet, other things may be advantageously added. A little stale white-bread or milk-biscuits may be crumbed into the milk. As dentition progresses, the child will relish and will get nourishment, if allowed to suck, and thereby ease his gums, with a small bone or bit of tender beef. If he be of a costive habit, a little simple molasses gingerbread may be allowed. It will

usually be well borne, and will tend to keep the bowels open. The child should not be weaned, but should be kept to such simple food as this till sixteen or eighteen months old. From that period till puberty the simplest and most nourishing diet should be continued. Of meats I have thought that it would be well if he were more closely confined than is usually done; to beef and mutton, fish or fowl; and one or two vegetables, and the simplest of puddings. But pork, salted meats, hams, pickles, various kinds of pies and cakes should be avoided.

I am acquainted with two families, in each of which the consumptive tendencies were VERY STRONG, and both have escaped hitherto the scourge. They both followed this generally named very simple diet, and both had air in abundance. All the children are now beyond middle life, and some are old, and have as yet shown no tendency to consumption. In contrast to these I have known of two other families not hereditarily predisposed to consumption. They both had pork as their *principal article of diet*. Both have been cut down by consumption. I have no right to make a definite inference from such a small array of facts; but until the contrary be proved I think it well not to neglect even these few, embracing, as they do now, over fifty individuals. No harm can arise from using the simplest food, and possibly a great good may be derived from so doing.

From puberty till adult life a similar simplicity of food would be advisable; but more varieties may be used. In fact, this would be inevitable in the struggles and changes of life. But this is just the period when a fickle, weak judgment, and still more, perhaps, an unbridled will, tend to carry the youth of both sexes into excesses. It is the period of joyousness, and it revels in the sense of freedom. It needs to be gently led, sometimes with infinite kindness and caution, but at the same time with decision; and, as a physician, I know of nothing more important therefore upon this most important subject. At this period the two sexes show different tendencies. The maiden is apt to have a capricious appetite, or perhaps has little or no appetite. At times she arrives at the most false conclusion that she should not eat

at all because of want of appetite, or that she may eat the most unnatural articles because she likes to do so. She chews up pencils, chalk, charcoal, or some other equally noxious thing, and refuses the roast beef and bread. She prides herself upon these vagaries, or she secretly indulges her diseased tastes. She thinks herself different from all others, and a kind of martyr to the persecutions of the world, that would thrust into her unwilling stomach the hated but nutritious food. If she reject all advice upon the subject, there is a deterioration of the whole stamina of life, and she thus renders herself more liable to the subtle influences of her race. Dyspepsia is apt to set in, and soon perhaps a "common cold" will cause a cough which may terminate only with her death. Far different usually are the tendencies of the young man during this period of his life. It is the period of passion and appetite for the gratification of all the instincts of life. Woe betide the youth who runs riot, and reduces his animal vigor by thoughtless license of food and drink, or in other ways during this period. Cautious guidance without seeming to guide, is the best rule. Let home be the happiest place he can find. Let the table be spread with a sufficient variety of food to tempt both male and female, but let wisdom select the articles. Simplicity and nutritiveness should be the main object held in view by the parent, but not by so strict a rule as should be followed during the earlier period. The question of alcohol may come up during this period with telling power. Doubtless, under a judicious guidance, wine, and even stronger liquor, may be occasionally used by the youth of both sexes, when from some cause there is evident debility, and consequently there may seem to be reason for their use. Excellent lessons in a true temperance may be instilled by a wise guardian on such occasions, even while administering liquor, which if used intemperately, could bring on drunkenness or death. But such a use of strong drink should be only occasionally indulged in, and be immediately abandoned after the recovery of health. An undue and intoxicating indulgence in the use of liquor in this early period is more liable, I think, to sap the sources of health than it may be beyond

the period of adult life. At the former period it tends, I have thought, to develop phthisis, by its general deterioration of the system.

From adult to middle life and old age the patient will decide for himself. The same general rules for using regularly and carefully a simple but nourishing food should be carried out during the later period of life. If the education have been wise the requisite habits will have been formed. Good food has been taken regularly each day, and each day a certain amount of materials no longer fit for nutrition has been discharged. That the latter part of this statement should be literally fulfilled is perhaps the most important rule that can be adopted by any person during the whole of life. Irregularity of the bowels or obstinate constipation is the evil of this climate. It is so almost constantly one of the antecedents of consumption, that I have been led to think it is one of the conditions to be avoided by every one who, being predisposed to consumption, would escape the disease. This end should be gained by laxative food and other analogous influences rather than by drugs, although these last are often invaluable as adjuvants. Advance being made in life, the only change I would suggest for one in adult life and predisposed to consumption is the more constant daily temperate use of sherry wine, of cider, beer or ale or some of the coarser liquors. Nature seems to need a stimulus of this kind, and responds gently to it. A *certain quantity* should be adhered to. For example, after perhaps thirty or forty years of age two glasses of sherry wine or an equivalent in beer or any alcoholic liquor may be generally used with advantage. Life will be made more vigorous and cheerful, and the consumptive tendency lessened. I should in certain individuals begin at a much earlier age to use these stimulants. But, listening to the warnings of prudence, and knowing the tendency to increase the amount used, and holding up always the horror of intemperance, I should never advise the *general use* of any liquor at an early peirod. Nor do I think any parent or physician justified in so doing.

Clothing.

This should vary with, 1st, the season, or even with the hour; 2d, with the individual; and, 3d, with the age of the individual. The following very general rules may be laid down; but of course they may be varied with reference to the peculiarities of each person, some requiring more and some a less amount. Our climate is subject to excessive and sudden changes from heat to cold, and *vice versa*. Hence, changes of clothing will often become necessary, especially by those who have a great liability to "taking cold," as those tending to consumption often have. These changes may in the spring or summer be required very frequently in short spaces of time, if the person would be perfectly safe. I have known an under-flannel vest put on twice, and taken off once, the same day. The morning and evening were very cool, while at mid-day it was so oppressively hot that any under-clothing could not be borne with comfort by the person. Such sudden changes will rarely be made, and are never allowable except with the greatest caution. They should be made only by adults, fully acquainted with their own constitutions, and prepared to run no risks. Of course all such persons are ready to resume any amount of clothing at evening that may have been taken off in consequence of excessive heat at mid-day. Common sense, moreover, must never be laid aside in this respect.

I have little doubt that as great an error is sometimes committed by clothing a child too warmly during a warm day, as by dressing him too lightly in a cold one. The skin is kept by this *over* clothing in constant perspiration. The child is made thereby sensible to the least draught or change of air, and more quickly "takes cold" than one less thickly clothed.

The underclothing should be, at least for the greater part of the year, of flannel. Some persons need this for the entire year. Of course the article should vary in thickness in winter, spring and mid-autumn. It should be very thick in the winter, medium in the spring, and almost of a gossamer character, or wholly omitted, in the hottest days of summer. Even in these last days the individual must always be prepared to use woollens in the morning and evening if a sudden change

of temperature occur. From these general remarks it may be seen that, while I would not martyrize certain individuals by requiring them to clothe in flannel during the entire year, I think it better that that should be the rule. Especially is this rule important and very rarely to be varied from in the case of any one having a tendency to consumption, in whom a trivial "cold" becomes at times a death-blow. And what shall we think of the wisdom of parents allowing their children to go bare-legged in New England in very cold weather, as some do, in following fashion? Or still more, what shall we deem the prudence of parents who allow their children, youths and maidens, to attend evening parties in low dresses and in thin shoes during the depths of our winter, and, after having danced violently and becoming heated, permitting them to return home covered at times very lightly? One cannot wonder that some fall ill. It is lucky that many more do not become victims after such folly.

To keep thoroughly warm, therefore, without being oppressively so, should be the aim of every age. The feet should be covered with thick-soled shoes in winter. In this respect fashion has of late done an actual good, since it compels even our young girls to "*tramp*" with soles and heels of ample thickness all the year.

None should ever remain long in wet clothing, unless so actively employed as to keep up a free circulation and warmth over the whole body. The neglect of this rule, my experience teaches me, is frequently productive of serious, and at times, fatal results. Finally, the clothing should never be so tight as to prevent the free expansion of the chest. Corsets should generally be avoided by all having pulmonary tendencies. It would be well if all female clothing were supported by straps over the shoulders, instead of from the tight waistbands, as is but too common among girls at the present time.

Care of the Skin—Bathing.

In immediate connection with the clothing naturally comes the care of the skin. This should be kept scrupulously, not only clean, but in a perfectly healthy condition by daily bathing in cool or tepid water. It is not well to allow any skin diseases to become chronic, if it be possible to prevent

them. At times I have seen the ceasing of a long-continued irritation of the skin coincide with a tendency to cough. I cannot say that the relation is that of cause and effect, but I simply note the fact. And therefore I do not like to know that any one threatened with consumption has had, up to about the commencement of the actual illness, a life-long cutaneous affection. We cannot, it is true, by any amount of cleanliness always prevent these affections from showing themselves, as they are often hereditary; but, by a want of cleanliness, the skin, even when not apparently diseased, is ill-fitted to perform its important part in the operations of the body. In order, therefore, that a child predisposed to consumption may have every obstacle, even the slightest, removed from his path for perfect health, the care of the skin becomes very necessary. Daily bathing, then, of some kind, from childbirth to old age, should be the rule. Some direct that the cold bath should be always used. I cannot think that this is a true doctrine. With a few children, and still fewer old persons, and very many adults, a morning cold bath is the most refreshing and exhilarating of operations. But with many either feeble adult, old or too young persons, a chill remains for some time after taking the bath, and the powers of life are exhausted instead of being invigorated by the stimulus. But those who suffer from cold bathing will usually be able to take with great advantage a daily tepid bath, and without the least chill or discomfort following it. Each individual arrived at years of discretion should judge for himself which of the two to choose. At certain periods of life he may use one or the other and be himself the judge as to the continuance of the one or the other by the effect left upon him. The parent, of course, will notice the effect upon the child and decide accordingly. Bnt there are various kinds of baths. The *shower-bath* is rarely used now. If used at all it should be so cautiously. *Sponge-bathing* is admirable, either with warm or cold water, according to circumstances of each case. But even this cannot be borne by many when a simple hand-bath, i. e., when the water is borne by the hand of the bather to various parts of the body, and the same hand or a warm towel used for friction afterwards. This is often infinitely refreshing when

other methods fail of being so. *Surf-bathing* should be very cautiously indulged in by all predisposed to pulmonary difficulties. Cough of a permanent nature has been at times started by incautious surf or any cold water, sea or river bathing, especially if the body be immersed for a long time. One of the most striking cases of consumption I ever had was distinctly traceable to a very long and cold river-bathing. Hence, we see that bathing, like every other good thing, if used immoderately, tends to cause evil rather than good.

It may be asked, if cold bathing be ever evil in its tendencies, how happens it that the "water-cure," so called, proves at times so good a thing. The answer is briefly this. A man once fairly "packed in a cold wet sheet" becomes in a very few moments bathed in a profuse warm perspiration. But the water-cure, used incautiously by persons who are not aware of its power or proper mode of application, becomes destructive and not restorative. One of the severest forms of inflamed lung and which lasted for months, threatening consumption, and which would probably have proved such in an older person, I saw in the case of a little girl whose mother undertook to cure a violent fever by bathing her two or three times in one night, in cold water drawn from a well in the country-house at which they were stopping. The general rule therefore is, bathe daily, but choose that method which proves immediately grateful to the patient, and let all consumptively-inclined patients beware of long continued surf or sea-shore or river bathing.

Recreation.

I deem this idea of play or of recreation to be important for every human being, and at every stage of life.

Americans usually do not consider it so. Very many in this country annually fall victims to the neglect of it, and to our over and never ending work. If death be not caused by the neglect of it, certain it is that pleasurable life is shortened, and early decrepitude caused by too great an amount of severe toil without relaxation. Particularly is this manifest when applied to the tender years of childhood and of youth. If such be the fact with healthy human nature, how much must be the effect upon those children unhappily born with

constitutions tainted by hereditary disease. These need an extra amount of recreation in order to be able to resist their evil tendencies; and yet it is but too common to see parents allowing the feeble child to keep constantly at his books, on the very ground that his weak health makes him disinclined to go out of doors for play or for exercise. *Such a child should be compelled to find some recreation in the open air.* Of course, children need more than adults; but in early adult age, when having finished the school-education, so called, the youth enters on life, he is apt to continue year after year in unremitting toil upon whatever work he may have undertaken. He "cannot find time," or his employer will not allow him to relieve himself of this burden. Bad as this is for the perfectly healthy youth, and my experience assures me that not a few clerks or students, without any hereditary taint, succumb under it, it will be much more dangerous for any one born of consumptive parentage. It seems to me, there is a great amount of ignorance displayed by people on this subject. As a general rule it may be stated,—every one ought, if possible, to leave his toil for a certain period each day, and devote himself to the healthful recreation of walking, or play of some kind. If possible, every clerk should walk daily two or three miles, and for a few weeks annually he should leave the city, fly to the woods or the sea-shore, and forget care and trouble amid scenes wholly different from those of city life. A camp in the woods, with a necessarily perpetual change of air with each breath that is drawn, or a yachting excursion, or a pedestrian tour even in the immediate vicinity, would give a gracious refreshment for the mind and body of the steady worker in the city or college. Such recreations should increase in length, as years increase after adult life. If these remarks apply to all, they apply with twofold force to those having consumptive tendencies, certainly until after firm health has been established into a fully completed adult life. Every parent therefore should hold this as one of the most sacred rules for the physical development of his child. I deem it paramount to all other considerations; for, I repeat that nothing can be worse for all youths, especially those hereditarily consumptive, than a too close and constant attendance at school, college, or the

counting-room; and a parent or employer, who sees a child or clerk steadily growing thinner and weaker under hard work of any kind, and does not immediately relieve him, not merely consents to his subsequently having a life of impaired health, but often actually contributes to his death.

Education.

From what I have already stated, the inference may be drawn that I should advise every parent, especially the one supposed to be tainted with hereditary disposition to consumption to devote his whole attention to the developing in the most perfect manner, the *body of his child*. If I could have any influence from long professional experience I would urge this idea as one above all others important. Let the mind in early years, till the age of ten or twelve or puberty grow naturally and freely without many books. A child is perpetually learning. A wise parent would lead the boy or girl to observe everything around him in nature, and thereby the youth would be "educated" quite as well, and perchance better than from books, for while thus gaining strength of muscle he will educate the mind. I do not mean the child should be left untrained. Far from it. The training of a child of consumptive parents is above all things necessary. He should be taught self-restraint, and his hours should be well regulated even for his out-door pursuits. But *close* "schooling," technically so called, should be used with the greatest caution. These rules become still more important during the period from puberty to manhood or womanhood. During this period of life in our society, the child will usually be at school, and the greatest caution should be then observed. If at any time the youth or maiden appear prostrated even by common and the lightest *work*, immediate recreation should be given. This should be done at the expense apparently of time, and perhaps in opposition to the present comfort, happiness and wishes of both parents and child. A year or two given up to partial or entire relaxation from intellectual work will, at this period of life, often determine the future health and life of the child.

Here is one of my most frequent experiences as a consulting physician. A parent brings his child to me, in order to find

out what is the matter with him. On inquiring, I find that he has been to school, very much interested in his studies, that the teachers and parents have stimulated him constantly, or allowed him, without the least care of his physical health, to study without ceasing in order to get high marks or prizes, and to stand high in his classes at school. Instead of checking his ambition, the parent has encouraged this overwork. By so doing he is merely following the pernicious influence exerted by every school and college in the land. Instead of teaching a child that it should not compare itself with another, but should make itself what its own powers indicate it ought to be, every college and school inculcate exactly the reverse. By "marks" or prizes, or competitive examinations, the greatest emulation is often excited between individuals, and the weaker ones "in this struggle for life," are crushed by the severe process. I find almost invariably in such patients that the prize gained, or an examination concluded, is the signal for entire decay of physical powers under the violent strain put previously on the mind, and with a total neglect of corresponding physical exercise. Many such, far advanced in consumption, consult me. Hence there is abundant reasons for the strong opinions I hold on the necessity of care in the education of children and youth hereditarily disposed to consumption. In a consumptive family the steadfast rule should be *that the mind be wholly subservient to the body's welfare.* By this rule we shall not lower the mind, but only develop, if that be possible, a sound mind in a healthy body.

Profession and Trade.

The choice of a proper trade for a young man or a young woman, having hereditary tendency to consumption, would seem to be an easy matter. Of course one would say it would be well to have one that would give an abundant supply of fresh air and of such robust but not excessive employment as would exercise the whole body. It would evidently be well to avoid every profession that would not afford these necessities of life. A trade compelling one to inhale a dusty atmosphere, the machine-shop and metal-working of all kind causing a fine floating dust, would be bad. A profession requiring constraint and a bent position of the chest would be

plainly improper. The clerical profession, which makes man a close student and exercises the organs of voice even to exhaustion, which bends the chest over the desk, which necessarily exposes the patient at times to the cold open air in public services, should be avoided. Generally all clerical and sedentary and in-door employment should be either wholly avoided or used only a part of each day, because it is essential for perfect health in such cases that no air should be breathed twice. If it be necessary, or thought necessary, to adopt such sedentary occupations, the remarks on proper ventilation of the house (see section on Residence) become doubly important.

Notwithstanding these remarks may seem to some readers the veriest truisms and rules that none will forget even without professional advice, and which certainly would be attended to when once brought to the notice of any individual, I feel sure that very few in this community or any other obey these very obvious and simple rules. Nay, more; I will declare that the vast majority will argue, for one reason or another, to set them aside, hoping all the while that they or their children will be exceptions to the rule, and may, therefore, violate with impunity nature's most distinct laws. In the far future, I hope that Preventive Medicine will be able to convince people of their great power, and that therefore we should no more hope to escape the suffering, incident to a violation of them, than we could hope to evade the penalties that fall upon those who violate the law of gravitation or who wilfully or foolishly attempt to set aside any other of Nature's grand laws of life.

Exercise.

Closely connected with the subject of recreation is the matter of exercise. Every human being needs a certain amount of exercise; and yet every human being seems at the present day always endeavoring to avoid it. Our steam and horse cars, while they have done such immense service to the world, have produced one evil, viz.: they have induced among all classes an indisposition to walking, even for short distances. Our climate, it must be confessed, from its excessive heat in summer and cold in winter, usually prevents all of us from

taking the long walks which are enjoyed by almost every one in England. There they make a pleasure of a five or ten mile tramp over hill and dale. With us, nowadays, it is a labor, and being always busy, we deem it a waste of time; and yet there never was a greater error. A pedestrian tour undertaken by young persons, while affording constant pleasure if one only keeps his senses open to Nature, is probably the most effectual mode of exercising the whole body. No other kind of exercise so thoroughly and economically gains that end, and so tends to keep at bay any hereditary tendency to pulmonary disease.

It is right to dwell upon this topic, because the proper kind and amount of exercise is a most important element for success in warding off consumption. As such it should be attended to by parent and guardian, and by the man or woman long after guardianship shall have been outgrown. Indeed, without a sufficiency of it during the whole of life, the person predisposed to consumption will have his or her tendencies in that evil direction increased many fold. It must generally be in the open air, and daily, No amount of physical exercise in-doors will be sufficient. It must be taken by both sexes, in all weather, unless during the most stormy, or when the person is temporarily, from any cause, decidedly and acutely ill. But this plea of invalidism must not be urged for any length of time; otherwise more trouble will arise from the confinement than from the exposure.

There are various kinds of exercise. Some are better than others. Some may become either directly or indirectly prejudicial.

I will name the following as among the principal means of exercise:—1. Walking. 2. Running, or Foot Racing. 3. Dancing. 4. Horseback. 5. Driving (open or closed carriage). 6. Gymnastic Exercises (hard, light clubs). 7. Boxing. 8. Bowling. 9. Rowing. 10. Swimming.

Walking.

Of these the most universally applicable, and usually the best form of exercise, is walking. As stated above, unfortunately our climate with its snows and intense cold in winter and equally intense and depressing heat in summer, prevents

all of us from walking as much as would be useful or as much as can be done in some other countries throughout the year. Whenever it is feasible, it probably exercises the whole body better than any other method. It becomes, however, very uninteresting, even in a large city, if made simply for health's sake. Therefore it is always well to combine with it another object, either of business or pleasure. Hence a profession that will compel out-of-door exercise is the best prescription one can give. I have in recollection now a case of a naturally feeble man who had very decided signs of pulmonary disease, with bleeding from the lungs. He was a newspaper-carrier when he called to see me after one of his bleedings. I feared, at that time, that exposure during the winter would be very pernicious and perhaps fatal to him. Under this exercise, however, taken daily in rain and storms of all weather, and by the use of cod-liver oil, he wholly recovered. Those of my patients who have most frequently recovered are they who, by advice, commenced years since, and still continue, several times daily, their "constitutional" walks around the "Common" in Boston (about a mile). They will continue to do so while they live, because they know from experience now that not only their health, but their real comfort, depend upon a strict attention to that course. Omission of that exercise for a single day perceptibly affects them unfavorably. Two more obvious advantages arise from this course :—

1. Every muscle in the body is gently and uniformly brought into action by the swing of the legs and arms, and consequently of the trunk in a vertical direction. The undulations made by the head, chest, and abdomen in a vertical plane are thus not only according to "Hogarth's line of beauty," but also in that tending to perfect health. Every internal organ is gently stimulated to more robust action. The circulation goes more freely and uniformly.

2. Never, in a common walk, does the person breathe twice the same air, because he is constantly changing his position. This fact alone is of incalculable advantage. Some writers contend that the re-breathing of air once partially used is one of the most fertile causes of consumption.

The most favorable time for walking is undoubtedly about mid-day in winter, and in the morning and toward evening in

summer. Late in the evening is less useful, because of the liability to dampness and coldness and absence of the sun's rays, which of themselves seem sometimes to put vigor into the animal frame, and their absence is correspondingly felt in a depression of the powers. Nevertheless, one cannot deny that there is a great energy sometimes given by a brisk walk in a cool, dry starlight or moonlight night, when the atmosphere seems not only free from all chilling moisture, but absolutely pure and infinitely exhilarating.

Running.

Should we allow a consumptive child to indulge inordinately in any exercise, as, for instance, in running? Ought older persons to do so for the sake of gaining a certain end, for example, reaching a certain horse-car or railroad terminus? Fast running I think pernicious. It produces violent motions of the heart and too rapid breathing, and consequently, great tendency of the blood to the lungs. Violent palpitations are always produced, and a breathlessness at times ensues, from which the patient never fairly recovers. The heart, it is true, is usually the chief sufferer. I have distinctly in mind a case of heart disease that began after such an over-exertion, and in consequence thereof, as I believe. Spitting of blood from the lungs has, at times, occurred. Neither of these effects tends to improve the general health, and not infrequently they injure the lungs, and therefore should be avoided by the consumptively inclined. Of course in the above remark I have intended only to condemn inordinate and forced running, continued for some time. I do not mean to prevent either child or adult from occasionally hastening his pace. It would be utter folly to try to check the natural instinct of a child, which makes him run and leap for joy. But all long-continued, violent, rapid running should be avoided by the consumptively inclined, as fraught with possible evil, and therefore prejudicial to their perfect health.

Dancing.

At appropriate hours and for a proper length of time nothing can be better. It promotes grace and ease of motion and positive health if used thus properly. Carried far into

the night, and under all the stimuli usually connected with our modern large dancing-parties, in which heat and fatigue of body are followed sometimes by long exposures to a bitterly cold atmosphere, it has not a single quality commanding the respect of one who would educate a consumptively-inclined child to perfect health. Not a few of my patients have referred to the dancing-party as one of the worst elements in causing the helpless state in which they have been when they consulted me.

Horseback Exercise.

Perhaps nothing can be better for the system of one tending to consumption than regular daily exercise of this kind. It is more exhilarating than a walk. One changes his atmosphere more thoroughly. It does not fatigue as walking or running, and therefore can be continued longer than either of these. It stimulates the circulation, with less bodily effort. Hence from earliest times it has been recommended as a remedy for those who have actually consumption commencing. One gentleman whom I knew, and who died at an advanced age of another disease, considered that he owed his recovery from severe lung disease, and threatened consumption, chiefly to daily horseback exercise for two years, and a regular walk subsequently three times daily until his death. It is true that during all that time he continued to use daily, as he began at twenty-eight years of age, his two glasses of sherry wine. Some may doubt the value of the latter prescription. I do not, but believe that the two means contributed to the finally good result, one aiding the other till the perfect cure was arrived at. The late Dr. Jackson had great faith in this kind of exercise. One gentleman, a physician, who had frequent hemorrhages, and to whom Dr. Jackson had prescribed horseback riding in his every-day business, neglected it, and drove in his chaise instead. Dr. Jackson met him, and said, "You will have a hemorrhage until you follow my advice exactly. Leave your chaise and get on horseback." That advice was followed, with cure as the result. Care in the selection of a horse is necessary. An easy pacer or galloper is better than a hard, square, solid trotter. The latter is apt to cause pains in the chest and undue fatigue.

Driving.

This is an easier kind of exercise, and may be used for those who are quite ill, or recently convalescent. But it is less healthful than either of the other methods. An entirely open carriage without any cover is the best kind of vehicle, except in the very coldest of weather. One open in front, as the chaise or buggy, phaeton, etc., stands next. The back and sides may be half thrown down, whereby the vehicle resembles the open wagon. The back should never be rolled up while the sides are erect, because the draught thereby produced will be liable to cause a cold, and consequent injury to the lungs. The closed carriage is the least valuable, and especially when the windows are allowed to remain shut, as they often are by some during the whole drive.

Gymnastics.

Doubtless gymnastics may increase the power of the muscles; but I greatly doubt whether they are of great service in warding off phthisis. Some who had been stalwart gymnasts I have met with in consumption. It is also suggested that the fact, that after great exertion and training apparently to perfect health, they suddenly cease from all exercise, causes the system to suffer. The swinging of heavy clubs around the head cannot be recommended. Less exercise than that with the arms at times causes hemorrhage in those consumptively inclined. The lighter kinds of gymnastics, as used in some schools, may be of more service. Nevertheless, all of them, from their very violence, cannot be as appropriate as the methods previously named.

Boxing.

Used carefully, this is a good exercise; yet there is often too much strain put on the heart and lungs, as in running, etc. Moreover, it may be questioned whether severe blows upon the chest are ever of use. Prize-fighters are said to be specially prone to consumption, and it is thought that the severe pounding they sometimes get upon the chest contrib-

utes to this result. I have now in my mind a case of confirmed consumption where, previous to an accidental but a severe blow upon the chest, the patient was perfectly well. But he had been ill from the moment of this blow. Hence I cannot recommend this exercise of boxing to any consumptively inclined.

Bowling.

This may be used unless hemorrhage has occurred. But at all times it should be cautiously allowed to the consumptively inclined, and wholly avoided by those who have once bled.

Rowing.

This tends to expand the chest, and if no racing be undertaken, may prove of great value. The combination which one gets of rowing, walking and camping-out in perfect mountain-air in the Adirondacks may be recommended as one of the best methods of spending in our northern climate a long vacation in tho summer.

Before the Pacific Railroad was built, I occasionally advised patients to try a trapping expedition to the western coast. One of my earliest patients wholly recovered his health while with Fremont in one of his earlier pioneer expeditions to the Rocky Mountains and the Pacific. During this trip all kinds of exercise were necessary, and, among others, rowing; and all was done with not only great advantage, but a complete recovery of my patient.

Swimming.

I will not condemn this exercise, but it must be used with great caution. Too long a stay in the water I have known to actually cause phthisis. I have already alluded to the case (page 48). The patient attempted to swim a stream. He was very much chilled and terribly fatigued. He was well, when he undressed on one side of the river. He felt very ill on his arrival at the other bank, as if he had taken a severe cold, was livid, etc. Cough set in immediately, and he was in advanced consumption when months afterwards I saw him.

Bathing in the surf has usually a tonic effect, but should never be continued too long; and to those consumptively inclined the sea-shore is rarely, if ever, to be recommended. In fact, mere residence on the sea-shore, where he meets the conflict between the land and ocean climate is unfavorable for the consumptive, compared with being in the interior (i. e. in a land climate), or quite off from the coast on an island (in an ocean climate).

I have thus given you my views of the grand scope of Preventive Medicine, and, as a most imperfect illustration of its future usefulness, I have run through a series of recommendations that I think any experienced physician might even now give, according to the principles and rules of action that will weigh with the physician of the future. And I believe that if these recommendations, with others that might be added by any family physician, should be *thoroughly* carried out by the parent during childhood, and by the man or woman when arrived at adult life, many that will die of consumption would escape that calamity.

In saying this I do not mean to intimate that during the whole period no other remedies, strictly so called, might not be necessary. Doubtless they would be; and of the exact mode of application of those remedies physiological experiment and clinical experience of physicians are teaching us more and more every day. I contend, therefore, that the physician of the future will stand higher than ever, as Preventive Medicine advances. In this statement I take a position exactly the reverse of that *assumed* by President Barnard in his late address before the Health Association at its recent meeting in New York. That gentleman quietly informed his medical hearers that their doom was sealed under the steady advance of modern science. Their services would become less and less necessary, and would finally be no longer needed by the laity. I think he is wrong and that my views are correct, because, while human free agency and human imperfection exist, while accidents, moral and physical, occur, there will always be some occurrences tending to injure health which no skill in prophecy can foresee. The

wise physician will therefore be summoned to act immediately on important cases of disease or threatened death. These he will meet not only by wise preventive regulations for the future health of his patient, but likewise by a careful administration of medicine, properly so called, during the actual attack.

I remain, gentlemen,
Your sincere friend and colleague,

HENRY I. BOWDITCH.

ON THE PRESENT CONDITION
OF CERTAIN RIVERS OF MASSACHUSETTS,

TOGETHER WITH

CONSIDERATIONS TOUCHING THE WATER-SUPPLY OF TOWNS.

A REPORT

TO THE

STATE BOARD OF HEALTH OF MASSACHUSETTS,

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ON THE PRESENT CONDITION OF CERTAIN RIVERS OF MASSACHUSETTS.

By an order of the legislature, passed April 6, 1872, the Board of Health were instructed to inquire into certain matters connected with the questions of sewage, sewerage and the water-supply. The text of this order may be found on the tenth page of the last (fourth) Annual Report, and in compliance therewith a report upon these questions was made a year ago to the Board by Dr. Derby, Secretary of the Board, and the writer.

During the present year the inquiry has been prosecuted further, having more especially in view a reply to the third clause of the article referred to,—"the increasing joint use of water-courses for sewers and as a source of supply for domestic use by the people of this Commonwealth."

It has been thought desirable to investigate the present condition of the running streams, partly to learn the extent to which they are now made the carriers and receptacles of refuse materials, and partly to put on record some detailed statements, to which future reference can be made in the event of apparently increasing contamination. This inquiry was begun last year on the Blackstone River, and this year has been made to embrace several of the rivers of Eastern Massachusetts, principally the Merrimack, Blackstone, Sudbury, Concord and Charles.

In endeavoring to ascertain the character of a natural water, and especially of a running stream, whether the examination be undertaken simply for scientific purposes or with reference to employing the water as a source of supply for domestic uses, it is important not to base too general statements upon the results of a single examination. The greater the number of conditions under which the samples

can be taken, and the larger the number of samples, the more complete will be the answer to the inquiry proposed. Many loose statements find their way into reports of water committees and water boards, in which the estimate of the character of a running stream is based upon the results of a single examination, made, possibly, under extremely favorable or extremely unfavorable circumstances. It has therefore been thought better for the present year not to extend the work over a very large number of streams, but rather to choose a more limited number of streams, and to make examinations at several different times during the summer, fall and winter. It has been proposed further to examine the water at the same localities once or twice during the spring of 1874.

Great care has been exercised in collecting the water for chemical examination, and, having a very strong feeling of the importance of this part of the investigation, I have made personal visits to the localities indicated in the tables, and have taken the samples, except in one or two instances, with my own hands, using every necessary precaution.

The chemical examination of the waters was made as soon as possible after the collection, being, as a rule, begun and finished on the following day. A somewhat detailed statement of the methods employed will be found in the Appendix to this Report. Most of the analytical work has been performed by Miss Ellen H. Swallow, A. M., in the laboratory of the Massachusetts Institute of Technology, under my own direction. I take pleasure in acknowledging my indebtedness to her valuable assistance, and in expressing my confidence in the accuracy of the results obtained.

The Merrimack River.

The Merrimack rises in New Hampshire. Its head-waters are the streams flowing from the granitic regions of the White and Franconia mountains; and Lake Winnipiseogee serves as a huge storage reservoir to equalize the flow of the river during the summer months. Of the 110 miles of its course, 40 are in our own State. Both in New Hampshire and in Massachusetts it receives contributions to its volume from almost innumerable brooks and small streams, and from

other tributaries of considerable size, such as the Pemigewasset, Contoocook, Suncook, Souhegan, Nashua, Concord, Shawshine and Spicket. The manufacturing interest upon its banks is very great. Concord and Manchester (N. H.), and Lowell and Lawrence (Mass.), lie directly upon the river, taking advantage of its waters as a source of power, drawing from it in some cases their water-supply, and using it also as a means of removing a greater or less portion of the refuse from their factories and their dwellings. The population of the principal towns upon the river was as follows, according to the census of 1870:—

Concord,	12,241
Manchester,	23,536
Nashua,	10,543
Lowell,	40,928
Lawrence,	28,921
Haverhill,	13,092

A few figures may give some idea of the extent of the manufacturing interest on the Merrimack within the borders of our own State. At Lowell there are some 75 mill buildings, in which about 16,000 operatives are employed. About 10,000 horse-power is derived from the river, and, in addition, steam-power is used to the extent of 6,000 horse-power. The Merrimack Manufacturing Company alone consumes, among other things, 7,500 gallons of oil per annum, 225,000 pounds of starch, 1,100 barrels of flour, 2,500,000 pounds of madder, 50,000 of copperas, 170,000 of alum, 200,000 of sumac, 1,120,000 of sulphuric acid, 300,000 of bark, 350,000 of soda-ash, and 40,000 of soap.*

At Lawrence there are some 25 mills (buildings), employing 9,000 operatives. The manufacturing industry is less at Lawrence than at Lowell, but it is still very considerable. The Pacific Mills, which is the largest corporation, use some 800,000 pounds of starch, 540 barrels of flour, 8,300 gallons of oil, etc.†

* These figures are taken from the "Statistics of Lowell Manufactures, January, 1873," published by Stone & Huse, Lowell.

† "Statistics of Lawrence Manufactures, January, 1872." Published by Geo. S. Merrill & Co., Lawrence.

Character of the River-Bed.

The river, as has been said above, has its beginning in the mountain-streams of New Hampshire, and for the greater part of its course flows over a rocky or gravelly bed, the banks becoming in some places quite high. In the vicinity of Concord, N. H., there are beds of clay, and in times of freshet considerable quantities of earthy matter are washed into and carried down by the river. The water ordinarily is clear, and possesses little color. At times of freshet, however, for some two months and more during the year,* there is a large quantity of suspended matter, made up of particles of sand and silicious minerals and, to some extent, of clay. The aggregate amount of this earthy material is enormous. Dr. Dana, of Lowell, a number of years ago attempted to estimate it, but of course the data for any such calculation are far from being sufficient. He says :—

"In the year 1838, during 23 days of freshet, from May till November, no less than 71,874,063 pounds of geine [i. e. organic matter.—W. R. N.] and salts rolled by the city of Lowell, borne seaward. During the five days of the great freshet, from January 28th to February 1st, 1839, no less than 35,970,897 pounds of the same matter rolled by at from the rate of 112,128 pounds to 20,405,397 pounds per day; each cubic foot of water bearing onwards from 1½ to 30½ grains. This is only the suspended matter. That which is chemically dissolved by the waters, the fine, filmy deposit, which occurs in a few days after the coarser and grosser matters subside, and the matter ordinarily suspended in the water of the river, added to the above for the year 1838, give a grand total of 839,181 tons of salts and geine which were rolled down in the water of the Merrimack River." †

* The periods during which this state of turbidity exists are "not usually of long duration, perhaps never more than three or four weeks at a time. Observations made and records kept at the Pacific Mills show the amount of turbidity is in direct proportion to the height of water in the river, and that it exists to a troublesome degree only after the water reaches a certain height; while the records of the Essex Company, extending over a series of years, show that the total number of days in each year when the water is at or above that height is less than 90."—*Lawrence City Documents*, 1872: *Report on proposed Water-works, p.* 31.

† A Muck Manual for Farmers, by Samuel A. Dana. 16mo. Lowell, 1843, p. 180.

Dr. Dana made a chemical examination of the suspended matter, and states the composition of the coarser part, that which deposits more readily, to consist of—

Geine [organic matter], . .	3.92 per cent.
Silex, ...	72.70 "
Oxide of iron, ...	9.15 "
Alumina, ...	8.30 "
Lime, ...	0.51 "
Magnesia, ...	0.10 "

Mr. Burbank, of Lowell, has more recently examined this suspended matter. He found that a portion settled very rapidly, and consisted almost entirely of minute grains of fine, sharp sand; the portion of the deposit which settled after a longer interval of time was made up of finer sand, of scales of mica, of clay, of silicious infusorial remains, and of flocculent vegetable matter. The entire sediment from three gallons of river-water, taken April 29, 1869, and allowed to stand until it became perfectly clear, measured (wet) $\frac{32}{100}$ of a cubic inch.

The character of the country from which the Merrimack gathers its supply, and the nature of its bed, would lead us to expect to find the water naturally quite free from organic impurities, and this expectation has been borne out by chemical examination.

Present Condition of the River.

The results of the chemical examinations of water from different points of the course of the river are given in Table I., in which table the results are stated in "parts per 100,000." As, however, it has been the custom with many to give such results in "grains per gallon," a second table (I *a.*) is appended, in which they are so expressed.

The samples of water have been taken from the following localities:—

A. *Tyngsborough*, near the bridge now building, about eight miles above the dam at Lowell.

B. *Pawtucket Dam, Lowell.*—This dam is situated at the upper part of Lowell, just above the bridge which connects Lowell and Dracut. The dam diverts the water on the

Lowell side into two canals belonging to the "Proprietors of the Locks and Canals on the Merrimack River." The canals convey the water to the various manufacturing corporations.

The heights of the water in the river at Lowell on the various days when examinations were made were as follows at 6.30 A. M. :—

July 10,	. . .	2 feet 1 inch above top of dam.
September 2,	. .	2 " 0 " "
" 8,	. .	2 " 2 inches above top of dam.
" 10,	. .	2 " 0 " "
November 13,	. .	1 " 11 " "
December 31,	. .	2 " 3 " "

Two or three weeks previous to the November examination there had been quite a freshet, owing to heavy rains. At this time, however, the amount of suspended matter was very small.

C. *Hunt's Falls.*—Just below Lowell the Merrimack is joined by the Concord, a stream small in comparison with the river into which it flows, but not of inconsiderable size. It furnishes power (in all about 500 horse-power) to several manufacturing establishments. Below the junction of the Concord and Merrimack are "Hunt's Falls," where the river flows rapidly over a bed strewn with boulders. The water at this point was of necessity taken near the shore. The current is rapid, however, even close to the banks, and samples were taken from both sides of the stream. As the factories are on the right-hand side of the river, and as the Concord enters on the same side, the character of the water is here very different at different parts of the current.

D. *Above Lawrence.*—From Hunt's Falls the river flows to Lawrence where it encounters the dam of the Essex Company, and is thus diverted to furnish power to the various manufacturing establishments. The locality from which the specimens were taken was about half a mile above the dam, near the boundary between Lawrence and Methuen and Andover. At this point the river is some 800 feet wide, and the

depth of the water at different points was found to be as follows:—

At a distance of	about	100	feet	from south shore,	. 27 ft.
"	"	200	"	"	. 37 "
"	"	400	"	"	. 36 "
"	"	600	"	"	. 23 "

E. *Below Lawrence.*—A short distance below Lawrence the canal which furnishes water to the larger corporations enters the river on the north side, and at about the same point the Spicket River also joins the Merrimack. The Spicket is a small stream. It receives drainage from some manufactories, and some sewage from dwellings. The canal on the south side of the river empties into the Shawshine River, which, in its turn, empties into the Merrimack somewhat below the mouth of the Spicket. The "station" chosen was below the mouth of the Spicket, and above that of the Shawshine. At this point the surface of the river is dotted over with bits of wool and cotton; the water is covered with a greasy film, and sometimes thickly strewn with flocks of soap-suds.

From what has been said of the magnitude of the manufacturing operations carried on upon the banks of the river (and nothing has been said of the very great number of paper-mills, grist-mills and small factories upon the numerous brooks and small streams which empty into the river), we might at first sight suppose that the effect would be to make the water very foul, and to cause it to be unfit to use for any domestic purpose. Inspection of the Tables I. and I*a*. (as well as of the Table I*b*., in which are collected mean results) will show that such is not the case; and if we observe the mean result of the examination of eleven samples taken from the river just below Lawrence, where to the eye it is the most filthy, we shall see that the amount of dissolved solid matter is very small.

TABLE I.—*Examination of Merrimack River.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water. Inorganic.	Organic and Volatile.	Total.	Chlorine.	Oxygen, cubic centimeters to the liter.	Temperature in centigrade degrees.
187	Thursday, Nov. 13, '73, .	Tyngsborough, . .	0.0044	0.0113	2.40	1.78	4.18	0.16	–	–
188	" " .		0.0044	0.0113	3.56	1.44	5.00	0.14	–	–
65[1]	Thursday, July 10, '73, .	Lowell, above Pawtucket dam, ...	0.0043	0.0091	2.24	1.72	3.96	0.14	–	–
66[1]	" " .		0.0048	0.0091	2.96	1.68	4.64	0.14	–	–
101[2]	Tuesday, Sept. 2, '73, .		0.0047	0.0153	1.76	2.32	4.08	0.14	–	–
108[3]	Monday, Sept. 8, '73, .		0.0060	0.0150	2.08	1.84	3.92	0.16	3.32	–
120[4]	Wednesday, Sept. 10, '73 .		0.0047	0.0104	1.56	1.44	3.00	0.10	1.84	20.0
121[5]	" " .		0.0044	0.0100	1.80	1.84	3.64	0.12	–	–
122[6]	" " .		0.0045	0.0111	1.60	1.96	3.56	0.12	–	–
189[6]	Thursday, Nov. 13, '73, .		0.0040	0.0131	3.60	0.96	4.56	0.14	–	–
207[7]	Thursday, Jan. 1, '74, .		0.0053	0.0100	2.48	2.00	4.48	0.20	–	–
67[8]	Thursday, July 10, '73, .	Under Central Bridge, Lowell, . . .	0.0051	0.0113	2.08	1.68	3.76	0.16	–	–
68[9]	" " .		0.0040	0.0087	2.60	1.40	4.00	0.16	–	–
69[10]	" " .		0.0044	0.0093	4.64	1.44	6.08	0.16	–	–
70[11]	" " .		0.0053	0.0117	3.84	1.92	5.76	0.16	–	–
71[12]	" " .		0.0040	0.0080	3.80	1.16	4.96	0.18	–	–
109[13]	Monday, Sept. 8, '73, .	Below Lowell at Hunt's Falls. Right-hand side of river, . . .	0.0073	0.0289	3.40	3.08	6.48	0.28	1.89	–
110[13]	" " .		0.0047	0.0247	2.76	3.32	6.08	0.24	–	–
125[13]	Wednesday, Sept. 10, '73, .		0.0047	0.0206	3.16	2.64	5.80	0.22	–	–
126[13]	" " .		0.0049	0.0240	3.20	2.80	6.00	0.22	–	–
190[13]	Thursday, Nov. 13, '73, .		0.0044	0.0347	4.36	3.64	8.00	0.38	–	–

111[13]	Monday, Sept. 8, '73, .	Same locality, on left-hand side of stream, .	0.0020	0.0165	2.16	1.88	4.04	0.14	–	–
123[13]	Wednesday, Sept. 10, '73, .		0.0031	0.0143	2.20	1.72	3.92	0.14	–	–
124[13]	" " .		0.0020	0.0127	2.08	1.80	3.88	0.18	–	–
114[14]	Tuesday, Sept. 9, '73, .	Lawrence, above the dam,	0.0030	0.0105	2.20	2.00	4.20	0.20	1.81	20.5
115[15]	" " .		0.0044	0.0117	2.40	1.56	3.96	0.20	1.73	20.5
131[16]	Friday, Sept. 12, '73, . .		0.0073	0.0121	2.00	1.40	3.40	0.20	–	–
132[17]	" " .		0.0057	0.0113	2.00	2.20	4.20	0.20	–	–
145[18]	Thursday, Sept. 18, '73, .		0.0043	0.0127	2.20	1.40	3.60	0.20	1.79[20]	19.5
146[19]	" " .		0.0040	0.0107	2.16	1.48	3.64	0.20	–	–
147[21]	" " .		0.0040	0.0120	2.80	1.60	4.40	0.20	2.05	19.0
148[22]	" " .		0.0037	0.0100	2.92	1.60	4.52	0.20	–	–
163[23]	Thursday, Sept. 25, '73, .		0.0043	0.0087	2.80	1.80	4.60	0.18	3.20 3.15	18.0
164[24]	" " .		0.0043	0.0087	2.76	1.64	4.40	–	–	–
165[25]	" " .		0.0040	0.0117	2.28	1.68	3.96	0.16	3.16	18.0
166[26]	" " .		0.0040	0.0117	2.36	1.88	4.24	0.16	–	–
127[27]	Friday, Sept. 12, '73, . .	Below Lawrence, just above the mouth of the Shawshine River, .	0.0051	0.0147	2.56	2.04	4.60	0.20	–	–
128[28]	" " .		0.0029	0.0120	2.20	1.76	3.96	0.16	–	–
129[29]	" " .		0.0033	0.0137	1.80	1.60	3.40	0.16	–	–

[1] Entrance to new canal. At surface. [2] Opposite Inlet-chamber, 100 feet from shore. The unfiltered water gave, inorganic, 2.00; organic, 2.40; total, 4.40.
[3] Entrance to new canal. Strong wind blowing. [4] Opposite Inlet-chamber. At surface. [5] Opposite Inlet-chamber, 6 feet below surface.
[6] Entrance to new canal. [7] Taken by Geo. E. Evans. 7 feet below surface. [8] Under centre of left-hand span. 1½ feet below surface.
[9] Under centre of left-hand span. 6 feet below surface. [10] Under centre of middle span. 1½ feet. [11] Under centre of middle span. 6 feet.
[12] Under centre of middle span. 10—12 feet. [13] These samples were taken from the shore. The current is, however, very rapid even close to the banks.
[14] Taken about one-half mile above dam. Middle of river. [15] Taken about one-eighth mile above dam. Middle of river. [16] Just above dam. Middle of stream.
[17] Just above dam. 6 feet below surface. [18] One-half mile above dam. About 200 feet from south shore.
[19] Just above dam. Middle of stream. 6 feet below surface.
[20] Two other determinations in the middle of the stream, made at localities but slightly removed from each other, gave 1.85 c.c. and 1.83 c.c., respectively, at a temperature of 19.25° C.
[21] Just above dam. Middle of stream. 12 feet below surface. [22] Just above dam. About 200 feet from north shore. 6 feet below.
[23] Same as No. 145. [24] Same as No. 146. 6 feet below. [25] Same as No. 147. 12 feet below. [26] Same as No. 148. 1½ feet below.
[27] Taken near right-hand shore. 1½ feet below. [28] Taken near middle of stream. [29] Taken near left-hand bank. Centre of most rapid current.

TABLE I.—*Examination of Merrimack River*—Continued.

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water. Inorganic.	Organic and Volatile.	Total.	Chlorine.	Oxygen, cubic centimeters to the liter.	Temperature in centigrade degrees
150[30]	Thursday, Sept. 18, '73, .	Below Lawrence, just above the mouth of the Shawshine River, .	0.0024	0.0100	2.60	1.96	4.56	0.20	–	–
151[31]	" " .		0.0040	0.0140	2.36	1.84	4.20	0.20	–	–
152	" " .		0.0035	0.0148	3.16	2.04	5.20	0.20	–	–
167[32]	Thursday, Sept. 25, '73, .		0.0027	0.0150	2.96	1.36	4.32	0.16	3.30	–
168[33]	" " .		0.0013	0.0110	3.16	1.24	4.40	0.16	–	–
169[34]	" " .		0.0020	0.0120	2.68	1.76	4.44	0.16	–	–
117	Wednesday, Sept. 10, '73, .	Between Lawrence and Haverhill, . . .	0.0026	0.0101	2.72	2.08	4.80	–	–	–
118	" " .		0.0040	0.0127	2.84	2.00	4.84	0.18	1.74	–

30 About 200 feet from south shore. 31 Taken at different points near the north shore. In the current. 32 About 250 feet from north shore.
33 About 250 feet from north shore. 4—5 feet below. 34 About 250 feet from south shore.

TABLE I *a.*—*Examination of Merrimack River.* [Results expressed in Grains per U. S. Gallon.]

Number.	DATE	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water. Inorganic.	Organic and Volatile.	Total.	Chlorine.	Oxygen, cubic inches to the gallon.	Temperature in degrees Fahr.
187[1]	1873—Nov. 13,	Tyngsborough,	0.0026	0.0066	1.40	1.04	2.44	0.09	–	–
188	"		0.0026	0.0066	2.08	0.84	2.92	0.08	–	–
65	July 10,	Lowell, above Pawtucket Dam,	0.0025	0.0053	1.31	1.00	2.31	0.08	–	–
66	10,		0.0028	0.0053	1.73	0.98	2.71	0.08	–	–
101[2]	Sept. 2,		0.0027	0.0089	1.03	1.35	2.38	0.08	–	–
108	8,		0.0035	0.0089	1.21	1.07	2.28	0.09	0.77	–
120	10,		0.0027	0.0060	0.91	0.84	1.75	0.06	0.43	68.0
121	10,		0.0026	0.0058	1.05	1.07	2.12	0.07	–	–
122	10,		0.0026	0.0065	0.93	1.14	2.07	0.07	–	–
189	Nov. 13,		0.0023	0.0076	2.10	0.56	2.66	0.08	–	–
207	1874—Jan. 1,		0.0031	0.0058	1.45	1.17	2.62	0.12	–	–
67	1873—July 10,	Under Central Bridge, Lowell,	0.0030	0.0066	1.21	0.98	2.19	0.09	–	–
68	10,		0.0023	0.0051	2.52	0.81	2.33	0.09	–	–
69	10,		0.0026	0.0054	2.71	0.84	3.55	0.09	–	–
70	10,		0.0031	0.0068	2.24	1.12	3.36	0.09	–	–
71	10,		0.0023	0.0047	2.21	0.68	2.89	0.10	–	–
109	Sept. 8,	Hunt's Falls, Lowell, Right-hand side,	0.0043	0.0168	1.98	1.80	3.78	0.16	0.44	–
110	8,		0.0028	0.0144	1.61	1.94	3.55	0.14	–	–
125	10,		0.0028	0.0120	1.85	1.54	3.39	0.13	–	–

[1] For remarks see Table I.

[2] The unfiltered water gave: inorganic, 1.17; organic, 1.40; Total, 2.57.

TABLE I *a*.—*Examination of Merrimack River*—Continued.

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water. Inorganic.	Organic and Volatile.	Total.	Chlorine.	Oxygen, cubic inches to the gallon.	Temperature in degrees Fahr.
126	1873—Sept. 10,	Hunt's Falls, Lowell. Right-hand side,	0.0029	0.0140	1.87	1.63	3.50	0.13	–	–
190	Nov. 13,		0.0026	0.0203	2.55	2.12	4.67	0.22	–	–
111	Sept. 8,	Hunt's Falls. Left-hand side,	0.0012	0.0096	1.26	1.10	2.36	0.08	–	–
123	10,		0.0018	0.0083	1.28	1.00	2.28	0.08	–	–
124	10,		0.0012	0.0074	1.21	1.05	2.26	0.10	–	–
114	9,	Lawrence, above dam,	0.0018	0.0088	1.28	1.17	2.45	0.12	0.42	68.9
115	9,		0.0026	0.0068	1.40	0.91	2.31	0.12	0.40	68.0
131	12,		0.0043	0.0071	1.17	0.82	1.99	0.12	–	–
132	12,		0.0033	0.0066	1.17	1.30	2.47	0.12	–	–
145	18,		0.0025	0.0074	1.28	0.82	2.10	0.12	0.41[1]	67.0
146	18,		0.0023	0.0062	1.26	0.86	2.12	0.12	–	–
147	18,		0.0023	0.0070	1.63	0.93	2.56	0.12	0.47	66.2
148	18,		0.0022	0.0058	1.70	0.93	2.63	0.12	–	–
163	25,		0.0025	0.0051	1.63	1.05	2.68	0.11	0.74	64.4
164	25,		0.0025	0.0051	1.61	0.96	2.57	–	–	–
165	25,		0.0023	0.0068	1.33	0.98	2.31	0.09	0.73	64.4
166	25,		0.0023	0.0068	1.38	1.10	2.48	0.09	–	–
127	12,	Below Lawrence,	0.0030	0.0086	1.49	1.19	2.68	0.12	–	–
128	12,		0.0017	0.0070	1.28	1.03	2.31	0.09	–	–

129	1873—Sept. 12,	Below Lawrence,	0.0019	0.0080	1.05	0.93	1.98	0.09	–	–
150	18,		0.0014	0.0058	1.52	1.14	2.66	0.12	–	–
151	18,		0.0023	0.0082	1.38	1.07	2.45	0.12	–	–
152	18,		0.0020	0.0086	1.84	1.19	3.03	0.12	–	–
167	25,		0.0016	0.0087	1.73	0.79	2.52	0.09	0.76	–
168	25,		0.0008	0.0064	1.85	0.72	2.57	0.09	–	–
169	25,		0.0012	0.0070	1.56	1.03	2.59	0.09	–	–
117	10,		0.0015	0.0059	1.59	1.21	2.80	–	–	–
118	10,		0.0023	0.0074	1.66	1.17	2.83	0.11	0.40	–

[1] Two other determinations (see Table I.) gave 0.427 and 0.423 cubic inches, respectively.

TABLE I *b*.

	Parts per 100,000.			Grains per U. S. Gallon.		
	Mean of 11 Examinations above Lowell.	Mean of 12 Examinations above Lawrence.	Mean of 11 Examinations below Lawrence.	Mean of 11 Examinations above Lowell.	Mean of 12 Examinations above Lawrence.	Mean of 11 Examinations below Lawrence.
Ammonia, .	0.0047	0.0044	0.0031	0.0027	0.0026	0.0018
"Albuminoid Ammonia," .	0.0114	0.0110	0.0127	0.0066	0.0064	0.0074
Inorganic, .	2.37	2.41	2.64	1.38	1.41	1.54
Organic and volatile, . .	1.73	1.69	1.79	1.01	0.98	1.05
Total solid matter, . .	4.10	4.10	4.43	2.39	2.39	2.59
Chlorine, . .	0.14	0.20	0.18	0.08	0.12	0.11

What becomes of all the waste material daily thrown into the waters of the Merrimack?

This question has already been somewhat discussed in a previous report, but it may be well to recapitulate or re-state the facts and opinions there brought forward.

The principal causes which contribute to the apparent disappearance of the refuse received by the river are three, and these, in what I conceive to be the inverse order of their importance, are oxidation, deposition and dilution.

Oxidation.—Although it is not practicable, in the case of a running stream like the Merrimack, to trace the progress of the destruction of the organic material by oxidation, yet there is no doubt that a certain amount is so destroyed. The presence of nitrogen in the form of nitrites and nitrates is mainly due to the oxidation of nitrogenous organic material. The amount of nitrogen thus existing in the Merrimack, even below Lawrence, is so small that its determination would not afford much that is valuable as data of comparison. In the last report of the Board, the reasons are given which lead to

the belief that the effects of oxidation have been overrated, although they are not, on the other hand, to be depreciated. In this connection I made an attempt to ascertain whether any difference could be perceived in the amount of oxygen dissolved in the water at various points in the stream, such as above and below Lawrence and above and below Lowell. The results obtained may be found in the Tables I. and I*a*. As far as the direct end which was in view when the inquiry began is concerned, the results are negative. It is true that on September 8th the amount of oxygen in the river above Lowell (see No. 108) was found to be 3.32 cubic centimeters to the liter, while below the city (No. 109) only 1.89 cubic centimeters was found; but determinations made at other times showed a smaller amount above the dam; and, moreover, at the time No. 108 was examined, a stiff breeze was ruffling the surface of the river. Although a very considerable number of determinations, made at frequent intervals over a sufficiently long period of time might show some decrease of oxygen below the manufacturing towns, I did not feel that sufficient encouragement was afforded by the results obtained to warrant, at the present time, a very extended series of experiments. The total amount of oxygen seems very small,—much smaller than we might expect. Moreover, the amount was found to be quite uniform throughout the mass of the water, as may be seen by comparing Nos. 145 and 147, where water was taken not only from the surace, but also from a depth of some twelve feet.

Deposition.—Much waste material thrown into rivers is made up wholly or in part of substances insoluble in water. A portion, and a very considerable portion, even in a running stream, is deposited upon the bottom or stranded upon the banks. This deposition can often be very plainly observed in the immediate neighborhood of the points of discharge. Other chemical changes besides that of oxidation, alluded to above, take place, especially where the refuse is that from manufactories. Waste liquors from different manufacturing operations meet and cause the formation of new and, in many cases, of insoluble compounds. At the time of the spring freshets, much that during the summer may have been depos-

ited at one part of the stream, in the bed or on the banks, is washed up again, and, mingling with the earthy materials held in suspension, is swept onward to the sea, or, enveloped in the earthy matter, especially if this be of a clayey nature, is deposited lower down on the stream. This scouring action of freshets is, in fact, relied upon to keep the bed of the river clear in certain cases where a so-called *natural filtration* is adopted as a means of improving the quality of river-water which is to be used as a supply for domestic use.

Dilution.—By far the most important reason of the apparent disappearance of sewage and other waste material, is the fact that the amount of solid matter is so small compared with the volume of water into which it is thrown, that it is disseminated through the mass, and thus lost to observation, and, in many cases, to chemical tests.

If, in the examination of the Merrimack made at two such localities as above Lowell and then again below Lawrence, we find at the lower point no sensible increase of organic matter in a given bulk of water, the first explanation that suggests itself is, that the organic matter is so rapidly destroyed by oxidation as to leave no sign. A comparison of the results obtained in the chemical examination of the river above and below Lawrence may be instructive in this connection. Between these two points the river eceives the refuse from nearly all the manufacturing establishments, a large proportion of the excreta of the factory operatives, and a portion of the sewage of Lawrence. Moreover, the lower station is so short a distance below the city, that no chemist, probably, would believe that any considerable destruction of organic matter could take place in the rapid flow for so short a distance, and if, from chemical grounds, the evidence was not sufficient, the floating soap-suds, with still unbroken bubbles, and other materials borne down upon the current show the same thing. Now, in spite of this addition, we observe only a slight increase in the total solid residue and in the albuminoid matters, while in the *chlorine* there is an actual decrease. This last fact is of considerable significance. I regard the determination of chlorine to be of great utility. All natural waters contain a small proportion

of chlorine, very small in inland waters, slightly increased in waters near the sea. Chlorine is a universal accompaniment of sewage, generally in the form of chloride of sodium (common salt), and occurs also in most manufacturing refuse. All the chlorine used in the process of bleaching is eventually washed away, and that contained in the various compounds of this element which are used in dye-houses and print-works, finds its way in the end into the drains of the establishments. On this account, although harmless in the combinations in which it exists, its presence indicates the presence, now or formerly, of refuse material. Of course, in regions containing salt-springs and salt-deposits, these statements would not hold good, but our rivers normally contain but a very small proportion of chlorine. It is to be remarked further, that most chlorides are quite soluble in water, and that the chlorine compounds would have no tendency to deposit in an insoluble state,* so that, in a running stream, I do not see that there could be any sensible decrease except as a result of dilution.

Now, although a large quantity of chlorine compounds are being thrown into the river at Lawrence, yet there is no apparent increase of the proportion of chlorine in the water below the city. In this case we have a substance readily traced. The chlorine cannot escape from the river in gaseous form, nor does it deposit in insoluble combination, and yet the first inspection of the analytical results would lead, perhaps, to the conclusion that there was no real increase of impurity. From these considerations it is evident, that in the case of the soluble *organic matter* it is not necessary to suppose any destruction or decomposition; the apparent decrease or lack of increase may be explained, as in the case of chlorine, by the fact of dilution, and where the distance between the two points of examination is so short as in the instance now under discussion (above and below Lawrence), this is no doubt the main cause concerned.

* It is, of course, true that there are insoluble substances which contain chlorine, but there would be no opportunity for the formation of such. It is also asserted, that natural soils and earth-filters will retain or absorb even soluble chlorides; if this be so, it could not, in any way, cause a decrease of the amount of chlorides in a running stream.

In connection with this statement in reference to the chlorine, I was led to make an estimate of the amount of this element actually cast into the river at Lowell and Lawrence. To this end circulars were sent to the principal corporations in these cities asking for information with regard to the amount of chlorine-containing substances actually used by them. From these replies, it would seem that from the manufacturing operations at Lowell, chlorine to the amount of 300,000 pounds annually finds its way into the river. The refuse of household operations and excremental matter which reaches the river may probably with safety be estimated to add as much as 400,000 pounds, making the total amount from Lowell 700,000 pounds. At Lawrence the amount derived from manufacturing operations may be taken as 500,000 pounds; from other sources, 300,000 pounds; in all, 800,000 pounds. Although this amount seems quite large, it is to be observed that in the river it becomes mixed with an enormous amount of water, and, indeed, the total amount of waste material thrown into the Merrimack is small compared with the great volume of water. I have been led, in fact, to make a calculation which shows that, if we take the average summer flow of the Merrimack at Lowell as being about 2,100 cubic feet per second,* in order to increase the solid matter in solution by the amount of one grain to the gallon, it would be necessary that there should be thrown into the river as much as 100 tons of *dry* material daily. This leaves out of the account the *insoluble* matters, and supposes the volume of water to remain the same; but as the volume of water is continually increasing, and as the soluble matter would be accompanied by a large amount of insoluble

* Various estimates have been made of the amount of water flowing in the Merrimack at Lowell. I have taken, as sufficiently reliable, the mean summer flow at 2,100 cubic feet, and the mean annual flow as 5,400 cubic feet per second. The amount of water brought down by the Concord River has never been estimated with any attempt at accuracy. I am informed by the treasurer of the Wamesit Power Company, which controls the water-power on this river, that an estimate of the flow in summer was made some years ago for mill purposes. This estimate was 288 cubic feet per second. At Lawrence the power is controlled by the Essex Company. The statements which I have been able to obtain as to the amount of water are as follows: the day-flow varies from 4,000 to 40,000 cubic feet, and in extreme floods reaches 90,000 cubic feet per second. The mininum flow (4,000 cubic feet) usually continues for about three months, but has continued for six months, as, for instance, in 1870. In the dry season the night-flow is about 4,000 cubic feet per second.

substances, a very much greater quantity would be necessary in order to cause such an increase as has been mentioned. When we consider that much of bulk of what we see cast into the stream is water, containing only a small proportion of solid matter, it will not surprise us that more effect is not produced upon the river. For example, urine contains only about four per cent. of solid matter, fæces only about 27 to 30 per cent., and I found last year that the mean amount of dissolved solids in Boston day-sewage was only six one-hundredths of one per cent. (0.06 per cent.).*

The waste liquors from many manufacturing operations are also quite dilute, and although sometimes the stream into which the refuse is poured is colored for a considerable distance, yet the actual amount of solid coloring matter may not be very large.

In addition to what has just been said, if we, instead of considering the summer flow of 2,100 cubic feet, take the mean flow, which is some 5,400 cubic feet per second, or the flow during a freshet,—as, for instance, when the water has a depth of nine or ten feet over the Lawrence dam,—we shall see that dilution alone is sufficient to account for the slight apparent effect of the discharge into the stream of much that is offensive and noxious.

Although the waste material thrown into the river is so largely diluted as to be almost lost to observation, we might be able to determine the increase of impurity between two points, if the amount of water at the points in question could be accurately gauged. But even in this case it would not be possible to infer too closely the amount to be attributed to any given source, for the river is continually receiving accessions to its volume by the infiltration of water from the surrounding country. Moreover, water is continually sinking through the bed of the river, and either through actual crevices in the rocky bed, or by a more slow process of percolation where the bed is gravelly, more or less water is finding its way to lower strata.

The relative amounts in this way lost and gained vary very much in different streams, the loss or gain being in some cases

* See Fourth Annual Report of State Board of Health, 1873, p. 71.

readily observed, but in some cases going on without observation. Thus the rigid scientific investigation of the amount of impurities carried down by a stream, and the increase or decrease of these impurities owing to natural or artificial causes, would be a very difficult problem. Most practical ends are, however, met by a knowledge of the proportional amount of impurity at any given point. As will be seen by the results of the chemical examinations, this proportion in the Merrimack is not large. The only thing which causes its waters to be ill-suited for any manufacturing operation is the suspended mineral matter with which it is, at some times, loaded; its use for domestic purposes will be discussed on subsequent pages.

Blackstone River.

An investigation into the condition the Blackstone River, which was begun in 1872, has been continued during the present year. A description of the course of the river has been already given. (See the last Annual Report of the Board, page 82, and following.) The results of the examinations then made are incorporated with those made the present year in Tables Nos. II. and II *a*. No further examination has been made of Mill Brook; the considerable number of examinations made last year seemed to render it, at this time, unnecessary. It is sufficient to say that the condition of things with respect to it is essentially the same, although analysis might, and probably would show, the amount of impurity to be somewhat increased.

Specimens of the water have, however, been taken at various times at the stone bridge, just below Quinsigamond Village, about a mile below the junction of Mill Brook and Kettle Brook. Here the water, although varying somewhat in character, is always very foul. The water is always turbid, carrying a considerable amount of matter in suspension; the surface is covered with a greasy scum, and on one occasion a dead dog was seen stranded on a rock in the middle of the stream, and had already begun to decay.

A comparison of the results of the examination of the water taken from this and from other localities on the stream, as shown in Table II., is very interesting. That there should

TABLE II.—*Examination of Blackstone River.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia.	Solid Residue of Unfiltered Water.			Solid Residue of Filtered Water.			Chlorine.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.	
–	October, 1872,	Mill Brook, above sewers, average of 12,	0.197	0.180	–	–	–	–	–	15.91	1.62
–	" "	Mill Brook, below sewers, average of 11,	0.343	0.029	–	–	–	–	–	14.90	2.74
99	Friday, Nov. 8, '72,	Mill Brook, before it joins Kettle Brook,	0.158	0.120	–	–	–	–	–	12.30	2.00
100	" "	Kettle Brook,	0.012	0.025	–	–	–	–	–	6.50	–
101	" "		0.045	0.040	–	–	–	–	–	8.00	0.80
35[1]	Monday, June, 30, '73,	Blackstone River, near	0.180	0.0257	–	–	10.6	3.40	3.40	6.80	0.86
36[1]	" "	Quinsig. Iron Works,	0.110	0.0250	–	–	11.2	4.10	4.40	8.50	0.80
81	Friday, July 18, '73,	Stone bridge over Black-	0.168	0.030	11.50	4.90	16.40	7.60	3.40	11.00	1.14
82	" "	stone, between Quin-	0.170	0.031	11.60	4.90	16.50	7.50	3.40	11.90	1.14
[1]133[2]	Monday, Sept. 15, '73,	sigamond Village and	0.370	0.0410	–	–	–	9.00	2.70	11.70	1.60
[1]134[3]	" "	Millbury,	0.380	0.0400	–	–	–	9.30	4.70	14.10	1.60
210[4]	Thursday, Jan. 22, '74,		0.019	0.0127	4.44	0.76	5.20	4.44	0.60	5.04	0.46
37	Monday, June 30, '73,	Wooden bridge above the	0.150	0.0305	–	–	10.60	5.40	5.00	10.40	1.16
83	Friday, July 18, '73.	Burling Mills,	0.045	0.0300	6.00	3.00	9.00	4.50	3.50	8.00	0.54
135	Monday, Sept. 15, '73,		0.025	0.0166	–	–	–	3.00	4.10	7.10	0.72

[1] Taken at different parts of the stream. [2] Oxygen 1.91 c.c. to the liter, the temperature being 19.75° C. [3] Oxygen 2.01 c.c. to the liter, the temperature being 19° C.
[4] Oxygen 8.25 c.c. to the liter. This determination was made in the laboratory, the temperature being 18° C.

TABLE II.—*Examination of Blackstone River.* [Results expressed in Parts per 100,000.]—Concluded.

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Unfiltered Water.			Solid Residue of Filtered Water.			Chlorine.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.	
84	Friday, July 18, '73, .	Old Canal, above the Burling Mills, . . .	0.1000	0.0300	5.40	5.50	10.90	4.50	2.70	7.20	0.60
136	Monday, Sept. 15, '73, .		0.0800	0.0200	3.70	4.70	8.40	4.00	3.00	7.00	0.84
102	Friday, Nov. 8, '72, .	R. R. bridge, just above Millbury, . . .	0.0450	0.0400	–	–	–	–	–	5.00	1.20
38	Monday, June 30, '73, .		0.0400	0.0165	–	–	–	4.50	2.50	7.00	0.48
85[1]	Friday, July 18, '73, .		0.0390	0.0165	5.00	4.00	9.00	3.80	4.20	8.00	0.68
86[1]	" " .		0.0415	0.0200	4.50	4.20	8.70	4.50	3.00	7.50	0.64
137[5]	Monday, Sept. 15, '73, .		0.0250	0.0220	3.20	4.90	8.10	3.30	3.20	6.50	0.68
211[6]	Thursday, Jan. 22, '74, .		0.0213	0.0120	4.12	0.76	4.88	4.12	0.68	4.80	0.42
103	Friday, Nov. 8, '72, .	Below Millbury Station, at wooden bridge,	0.0370	0.0250		–	–	–	–	5.70	1.20
75	Saturday, Sept. 28, '72, .	Below Millbury Village,	0.0340	0.0250	–	–	–	–	–	–	0.65
39[1]	Monday, June 30, '73, .		0.0320	0.0140	–	–	9.30	5.80	1.00	6.80	0.68
40[1]	" " .		0.0312	0.0140	–	–	9.00	6.00	2.00	8.00	0.64
138	Monday, Sept. 15, '73, .		0.0200	0.0200	5.30	2.00	7.30	4.70	2.10	6.80	0.80
212[7]	Thursday, Jan. 22, '74, .		0.0203	0.0133	4.52	1.84	6.36	4.28	0.92	5.20	0.44
74	Saturday, Sept. 28, '72, .	Saundersville, just before joining Quinsigamond River, Northbridge, .	0.0192	0.0232	–	–	–	–	–	6.24	0.50
72	" " .		0.0120	0.0224	–	–	–	–	–	6.68	0.30
68	" " .	Uxbridge, below Taft's Mill, ...	0.0060	0.0224	–	–	–	–	–	5.68	0.22
51	Thursday, July 3, '73, .		0.0068	0.1730	–	–	–	4.16	2.36	6.52	0.50
143	Wednesday, Sept. 17, '73,		0.0053	0.0147	–	–	–	3.88	2.20	6.08	0.52

67	Saturday, Sept. 28, '72, .	Between Uxbridge and Millville,	0.0030	0.1090	–				–	5.08	0.30
50	Thursday, July 3, '73, .		0.0043	0.0132	–	–		2.96	1.86	4.82	0.32
141	Wednesday, Sept. 17, '73,		0.0040	0.0147	–	–	–	2.88	1.72	4.60	0.40
49	Thursday, July 3, '73, .	Between Millville and Blackstone, .	0.0066	0.0120	–	–	–	3.04	1.96	5.00	0.36
140	Wednesday, Sept. 17, '73,		0.0073	0.0160	–	–	–	3.28	1.40	4.68	0.38
66	Saturday, Sept. 28, '72, .	Below Blackstone, .	0.0030	0.0190	–	–	–	–	–	4.80	0.23
104	Monday, Nov. 18, '72, .		0.0650	0.0350	–	–	–	–	–	6.50	0.60
47[8]	Thursday, July 3, '73, .		0.0064	0.0124	–	–	–	2.68	2.04	4.72	0.36
48[8]	" " .		0.0066	0.0131	–	–	–	2.84	2.08	4.92	0.36
139	Wednesday, Sept. 17, '73,		0.0044	0.0164	–	–	–	2.76	2.32	5.08	0.40
		Tributaries.									
73	Saturday, Sept. 28, '72, .	Quinsigamond River, .	0.0040	0.0216	–	–	–	–	–	3.40	0.25
71	" " .	Manchaug River, at Uxbridge Station, .	0.0052	0.0212	–	–	–	–	–	4.20	0.28
142	Wednesday, Sept. 17, '73,		0.0043	0.0153	–	–	–	1.92	1.68	3.60	0.22
70	Saturday, Sept. 28, '72. .	West River, below Uxbridge, .	0.0040	–	–	–	–	–	–	3.84	0.20
144	Wednesday, Sept. 17, '73,		0.0044	0.0157	–	–	–	2.12	1.72	3.84	0.32

[1] Taken at different parts of the stream. [5] Oxygen 1.42 c.c. and 1.64 c.c. to the liter, the temperature being 19° C. The oxygen determination, 1.42, was made on the left-hand side of the stream; the 1.64 on the right-hand side: both in water taken a few inches below the surface.

[6] Oxygen 7.80 c.c. Temperature at time of this determination was 18° C. [7] Oxygen 7.79 c.c. to the liter, the temperature at the time of examination being 18° C.

[8] From different points.

TABLE II *a*. *Examination of Blackstone River.*—[Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Unfiltered Water. Inorganic.	Solid Residue of Unfiltered Water. Organic and Volatile.	Solid Residue of Unfiltered Water. Total.	Solid Residue of Filtered Water. Inorganic.	Solid Residue of Filtered Water. Organic and Volatile.	Solid Residue of Filtered Water. Total.	Chlorine.
–	1872—Oct. –,	Mill Brook, above sewers, average of 12.	0.115	0.105	–	–	–	–	–	9.17	0.94
–	–,	Mill Brook, below sewers, average of 11,	0.200	0.134	–	–	–	–	–	8.70	1.60
99	Nov. 8,	Mill Brook, before it joins Kettle Brook,	0.092	0.070	–	–	–	–	–	7.18	1.17
100	8,	Kettle Brook,	0.070	0.015	–	–	–	–	–	3.79	–
101	8,	Blackstone River, near Quinsig. Iron Works,	0.026	0.023	–	–	–	–	–	4.67	0.47
35[1]	1873—June 30,		0.105	0.015	–	–	6.19	1.98	1.98	3.96	0.50
36[1]	30,		0.064	0.015	–	–	6.50	2.39	2.57	4.96	0.47
81[1]	July 18,	Stone bridge over Blackstone River, between Quinsigamond Village and Millbury,	0.098	0.018	6.72	2.86	9.58	4.44	1.98	6.42	0.67
82[1]	18,		0.099	0.018	6.77	2.86	9.63	4.38	1.98	6.39	0.67
133[2]	Sept. 15,		0.216	0.024	–	–	–	5.25	1.58	6.83	0.93
134[3]	15,		0.222	0.024	–	–	–	5.43	2.74	8.17	0.93
210[4]	1874—Jan. 22,		0.011	0.007	2.59	0.44	3.03	2.59	0.35	2.94	0.27
37	1873—June 30,	Wooden bridge above the Burling Mills,	0.088	0.018	–	–	6.19	3.15	2.92	6.07	0.68
83	July 18,		0.026	0.018	–	–	–	2.63	2.04	4.67	0.32
135	Sept. 15,		0.015	0.010	–	–	–	1.75	2.39	4.14	0.42
84	July 18,	Old Canal above the Burling Mill,	0.058	0.018	3.15	3.21	6.36	2.63	1.58	4.21	0.35
136	Sept. 15,		0.047	0.012	2.16	2.74	4.90	2.33	1.75	4.08	0.49
102	1872—Nov. 8,	R. R. bridge just above Millbury,	0.026	0.023	–	–	–	–	–	2.92	0.70
38	1873—June 30,		0.023	0.010	–	–	–	2.62	1.46	4.08	0.28

85[1]	1873—July 18,	R. R. bridge just above Millbury,	0.023	0.010	2.92	2.33	5.25	2.21	2.45	4.67	0.40
86[1]	18,		0.024	0.012	2.63	2.45	5.08	2.62	1.75	4.37	0.37
137[5]	Sept. 15,		0.015	0.013	1.87	2.86	4.73	1.93	1.87	3.80	0.40
211[6]	1874—Jan. 22,		0.012	0.007	2.41	0.44	2.85	2.40	0.40	2.80	0.25
103	1872—Nov. 8,	Below Millbury Station,	0.022	0.015	–	–	–	–	–	3.32	0.70
75	Sept. 28,	Below Millbury,	0.020	0.015	–	–	–	–	–	–	0.38
39[1]	1873—June 30,		0.019	0.008	–	–	5.43	3.39	0.58	3.97	0.40
40[1]	30,		0.018	0.008	–	–	5.25	3.50	1.17	4.69	0.37
138	Sept. 15,		0.012	0.012	3.09	1.17	4.26	2.74	1.23	3.97	0.47
212[7]	1874—Jan. 22,		0.012	0.008	2.64	1.07	3.71	2.50	0.54	3.04	0.26
74	1872—Sept. 28,	Saundersville,	0.011	0.013	–	–	–	–	–	3.64	0.29
72	28,	Northbridge,	0.007	0.013	–	–	–	–	–	3.90	0.18
68	28,	Uxbridge, below Taft's Mill,	0.004	0.013	–	–	–	–	–	3.32	0.13
51	1873—July 3,		0.004	0.010	–	–	–	2.43	1.38	3.81	0.29
143	Sept. 17,		0.003	0.009	–	–	–	2.26	1.28	3.54	0.30
67	1872—Sept. 28,	Between Uxbridge and Millville,	0.002	0.011	–	–	–	–	–	2.97	0.18
50	1873—July 3,		0.003	0.008	–	–	–	1.73	1.09	2.82	0.19
141	Sept. 17,		0.002	0.009	–	–	–	1.68	1.00	2.68	0.23
49	July 3,	Between Millville and Blackstone,	0.004	0.007	–	–	–	1.77	1.14	2.91	0.21
140	Sept. 17,		0.004	0.009	–	–	–	1.91	0.82	2.73	0.22
66	1872—Sept. 28,	Below Blackstone,	0.002	0.011	–	–	–	–	–	2.80	0.13
104	Nov. 18,		0.038	0.020	–	–	–	–	–	3.79	0.35
47[9]	1873—July 3,		0.004	0.007	–	–	–	1.56	1.19	2.75	0.21
18[9]	3,		0.004	0.008	–	–	–	1.66	1.21	2.87	0.21
139	Sept. 17,		0.003	0.010	–	–	–	1.61	1.35	2.96	0.23

[1] Taken at different parts of the stream.

[2] Oxygen 0.44 cubic inch to the gallon, the temperature being 67.5° F.

[3] Oxygen 0.46 cubic inch to the gallon, the temperature being 66° F.

[4] Oxygen 1.91 cubic inch to the gallon.

[5] Oxygen 0.33 and 0.38 cubic inch to the gallon, on different sides of the stream, the temperature being 66° F.

[6] Oxygen 1.82 cubic inch to the gallon.

[7] Oxygen 1.80 cubic inch to the gallon.

[9] Taken at different points.

TABLE II *a*. *Examination of Blackstone River.* [Results expressed in Grains per U. S. Gallon.]—Concluded.

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Unfiltered Water.			Solid Residue of Filtered Water.			Chlorine.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.	
		Tributaries.									
73	1872—Sept. 28, . .	Quinsigamond River, .	0.002	0.013	–	–	–	–	–	1.98	0.15
71	28, . .	Manchaug River, at Uxbridge Station, . .	0.003	0.012	–	–	–	–	–	2.45	0.16
142	1873—Sept. 17, . .		0.003	0.009	–	–	–	1.12	0.98	2.10	0.13
70	1872—Sept. 28, . .	West River, below Uxbridge, ...	0.002	–	–	–	–	–	–	2.24	0.12
144	1873—Sept. 17, . .		0.003	0.009	–	–	–	1.24	1.00	2.24	0.19

be so much difference in the character of the water at the same locality at different times, is not a matter to occasion surprise; it shows the value of a continued examination, and the error involved in allowing a single examination to fix the character of a stream, especially of one which receives much sewage-matter. The samples are arranged in the table in the order of the localities from which they were taken, proceeding from the upper part of the stream towards the mouth.

These examinations show a very different condition of things from that which exists in the case of the Merrimack. The Blackstone River receives, in the beginning, a very large amount of foul matter,—the sewage of Worcester. The various manufacturing establishments upon its banks contribute to its pollution. It is to be remarked, that the character of the bed is such, that the water as it flows seems, from its dark and turbid appearance, to be more foul than chemical examination shows it actually to be. Still, it is evident from an inspection of the table, that the amount of pollution is considerable. From a comparison of the water just below Quinsigamond Village with that below Blackstone, it appears that, in respect to the total amount of impurity, to the chlorine, in every respect in fact, the condition of the water is better at the lower part of the stream. In the case of the Blackstone we can see, more readily than in that of the Merrimack, how largely this apparent decrease of impurity is owing to the entrance of streams less polluted, and to water draining from the surrounding country.* We see, however, that the river at Blackstone still shows evidence of previous contamination. It may be remarked that, at the time of the examination made September 15 and 17, the river was quite low, although not at the very lowest point reached during the summer. At the time of the examination made January 22, the river was quite full. The temperature of the

* I am informed by a gentleman largely interested in the mills on the Blackstone River and tributaries, that no measurements have, to his knowledge, been made of the flow of the river at any point within the State. He estimates, however, the ordinary flow of the stream at the Rochdale Mills, at Northbridge, as being about 10,000 cubic feet per minute for twelve hours of each working-day. In Uxbridge, below the junction of the Blackstone and Manchaug Rivers, it is about 18,000 cubic feet per minute for twelve hours of each working-day, and above the point at which the Little Blackstone enters the main stream in Grafton, there is probably not more than two-thirds as great a flow as at Northbridge.

air at this latter date, was about 8° C. (46° F.), and there was little ice in the stream, although the water was near the freezing point.

Charles River.

Charles River rises in the extreme south-western part of Norfolk County, and its water-shed includes a whole, or a part, of the towns of Bellingham (population in 1870, 1,283), Franklin (2,512), Medway (3,721), Norfolk (1,081), Medfield (1,142), Sherborn (1,062), Natick (6,404), Dover (645), Needham (3,607), Dedham (7,342), West Roxbury (8,683), Newton (12,825), Weston (1,261), and Waltham (9,065). The river empties into Boston Harbor, and, as a tidal stream, flows between Watertown, Cambridge and Charlestown on the one hand, and Brighton and Boston on the other. At the upper part of its course there are a few mills upon its banks, and from South Natick to the sea there is a succession of dams which, as the river has no very considerable fall, causes the water to set back for some distance. After the river becomes a tidal stream, it receives a large amount of sewage from the cities on its banks. The water of the stream above Newton is, as yet, but little contaminated. The amount of dissolved matter is small, as may be seen by an examination of the accompanying table. Having, in many places, a by no means rapid flow, and winding through low, marshy land, the amount of organic matter of vegetable origin is, especially in the latter part of the summer and during the fall, quite considerable; the water then becomes somewhat strongly colored, and possesses a slightly unpleasant taste. The town of Brookline, with a view to the possible adoption of Charles River as a source of water-supply, had a number of chemical examinations made of the water at various times during the early part of the summer. The results of these examinations appear in the Brookline Water Report, September, 1873. For purposes of comparison, they are given the in the Appendix to this Report.

The amount of water flowing in Charles River above Newton, has been measured at various times. Gaugings, made during July and August, 1841, showed a flow of about sixty-four cubic feet per second; during the month of September,

1845, which was a dry month, the average flow was about thirty cubic feet per second. This is, of course, less than the mean annual flow. The river has recently been estimated to be able, with sufficient storage capacity, to furnish a daily supply of 50,000,000 gallons; as, in this estimate, only two-thirds of total flow is taken into account, this would be equivalent to about 118 cubic feet per second as the mean flow. (See Report of Cochituate Water Board on an Additional Supply of water, 1873, p. 60.)

The "stations" chosen for the collection of water for chemical examination, were as follows:—

A. *At South Natick*, at the dam.

B. *At Charles River Village*, above the dam.

C. *At Dedham*, Ames Street bridge.

C[1]. *At Dedham*, Spring Street bridge.

D. *At Needham*, Nahanton Street Bridge, near the gravel pits. Between C and D the river makes a bend, so as to flow almost in a circle, and forms in one place what might be called a pond (known as Cow Bay). Above the Spring Street bridge is located an establishment for cleaning sheep-skins, which, however, has seemed to be closed on every occasion on which the locality has been visited this summer. At this point (D) the river is very sluggish, it being, as a rule, quite difficult to say, from simple observation of the stream, towards which direction the water flows.

E. *At Newton Upper Falls*, above the dam.

F. *Below Newton Lower Falls*, near the "Riverside" station, on the Boston and Albany Railroad.

G. *At Waltham*.

TABLE III.—*Examination of Charles River.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water. Inorganic.	Solid Residue of Filtered Water. Organic and Volatile.	Solid Residue of Filtered Water. Total.	Chlorine.	Oxygen in cubic centimeters to the liter.
31	Saturday, June 28, 1873, .	South Natick, ...	0.0043	0.0120	3.10	1.80	4.90	0.38	–
32	" " 28, " .		0.0060	0.0100	2.70	1.30	4.00	0.34	–
15	Thursday, " 12, " .	Charles River Village, above dam, ...	0.0060	0.0209	3.40	1.80	5.20	0.30	–
33	Saturday, " 28, " .		0.0043	0.0127	2.00	2.00	4.00	0.34	–
34	" " 28, " .		0.0039	0.0146	1.80	3.20	5.00	0.34	–
16	Thursday, " 12, " .	Between Charles River Village and Dedham, . . .	0.0064	0.0189	2.00	2.50	4.50	0.30	–
182	Saturday, Nov. 1, " .		0.0053	0.0280	3.64	3.00	6.64	0.48	–
28	Thursday, June 26, " .	Dedham, Ames Street Bridge,	0.0100	0.0189	3.00	2.40	5.40	0.32	–
104	Friday, Sept. 5, " .		0.0057	0.0327	3.16	3.80	6.96	0.26	–
183	Saturday, Nov. 1, " .		0.0056	0.0280	3.72	3.20	6.92	0.48	–

17	Thursday, June 12, 1873,	Dedham, Spring Street Bridge,	0.0043	0.0165	2.60	2.7	5.3	0.30	–
29	" " 26, "		0.0076	0.0131	1.70	3.1	4.8	0.40	–
18	" " 12, "	Bridge near Needham gravel-pits,	0.0044	0.0179	2.20	2.70	4.90	0.30	–
30	" " 26, "		0.0073	0.0173	3.10	3.70	6.80	0.44	–
105[1]	Friday, Sept. 5, "		0.0066	0.0360	2.84	3.52	6.36	0.24	2.89
184	Saturday, Nov. 1, "		0.0044	0.0250	3.96	2.48	6.44	0.48	–
106[1]	Friday, Sept. 5, "	Newton Upper Falls, above dam,	0.0057	0.0368	3.40	3.92	7.32	0.26	2.95
107[1]	" " 5, "		0.0060	0.0340	3.04	3.76	6.80	0.32	2.73
97	Monday, Sept. 1, "	Below Newton Lower Falls and above Waltham,	0.0077	0.0307	3.20	3.16	6.36	0.26	3.23
98	" " 1, "		0.0060	0.0307	3.16	3.24	6.40	0.26	2.98
99	" " 1, "		0.0053	0.0407	3.40	3.24	6.64	0.30	–
100	" " 1, "		0.0064	0.0444	3.00	3.28	6.28	0.30	2.74
197	Tuesday, Dec. 16, "	Waltham,	0.0060	0.0164	3.88	1.84	5.72	0.40	–

[1] Nos. 105, 106 and 107 were found *after they had been carried to the laboratory* to contain dissolved gases as follows:—

No. 105, Nitrogen 9.10, Oxygen 2.84 c.c. per liter.
106, " 8.08, " 2.95 " "
107, " 7.68, " 2.73 " "

TABLE III *a*. *Examination of Charles River*.—[Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Oxygen in cubic inches to the gallon.
					Inorganic.	Organic and Volatile.	Total.		
31	June 28, 1873, . . .	South Natick, ...	0.0025	0.0069	1.81	1.05	2.86	0.22	–
32	" 28, " . . .		0.0035	0.0058	1.58	0.75	2.33	0.20	–
15	" 12, " . . .	Charles River Village, above dam, ...	0.0035	0.0122	1.98	1.05	3.03	0.18	–
33	" 28, " . . .		0.0025	0.0074	1.17	1.17	2.34	0.20	–
34	" 28, " . . .		0.0023	0.0085	1.05	1.87	2.92	0.20	–
16	" 12, " . . .	Between Charles River Village and Dedham, . .	0.0037	0.0110	1.17	1.46	2.63	0.18	–
182	Nov. 1, " . . .		0.0031	0.0163	2.12	1.75	3.87	0.28	–
28	June 26, " . . .	Dedham, Ames Street Bridge,	0.0058	0.0110	1.75	1.40	3.15	0.19	–
104	Sept. 5, " . . .		0.0033	0.0191	1.84	2.22	4.06	0.15	–
183	Nov. 1, " . . .		0.0033	0.0163	2.17	1.87	4.04	0.28	–

17	June 12, 1873, . . .	Dedham, Spring Street Bridge,	0.0025	0.0096	1.51	1.57	3.09	0.18	–
29	" 26, " . . .		0.0044	0.0076	0.99	1.81	2.80	0.23	–
18	" 12, " . . .	Bridge near Needham gravel-pits, ...	0.0026	0.0104	1.28	1.57	2.85	0.18	–
30	" 26, " . . .		0.0043	0.0101	1.81	2.16	3.97	0.26	–
105	Sept. 5, " . . .		0.0039	0.0210	1.66	2.06	3.72	0.14	0.69
185	Nov. 1, " . . .		0.0026	0.0146	2.31	1.45	3.76	0.28	–
106	Sept. 5, " . . .	Newton Upper Falls, above dam, ...	0.0033	0.0215	1.98	2.29	4.27	0.15	0.68
107	" 5, " . .		0.0035	0.0198	1.77	2.20	3.97	0.19	0.63
97	" 1, " . . .	Between Newton Lower Falls and Waltham, . . .	0.0045	0.0179	1.87	1.84	3.71	0.15	0.75
98	" 1, " . . .		0.0035	0.0179	1.84	1.89	3.73	0.15	0.69
99	" 1, " . . .		0.0031	0.0237	1.98	1.89	3.87	0.18	–
100	" 1, " . . .		0.0039	0.0257	1.75	1.91	3.66	0.18	0.63
197	Dec. 16, " . . .	Waltham, ...	0.0035	0.0096	2.27	1.07	3.34	0.23	–

In addition to the results recorded in Tables III. and III*a*. more complete analyses were also made of the water taken at NeedhamBridge, November 1 (No. 184), and of water taken at Waltham, December 16 (No. 197). The results obtained were as follows :—

	Parts per 100,000.		Grains per Gallon.	
	No. 184.	No. 197.	No. 184.	No. 197.
Ammonia,	0.0044	0.0060	0.0026	0.0035
"Albuminoid Ammonia,"	0.0250	0.0164	0.0144	0.0096
Inorganic,	3.96	3.88	2.31	2.26
Organic and Volatile,	2.48	1.84	1.45	1.07
Total solid residue,	6.44	5.72	3.76	3.33
Chlorine,	0.48	0.40	0.28	0.23
Sulphuric acid (SO_3),	0.54	0.89	0.32	0.52
Silica,	0.65	0.57	0.38	0.33
Alumina and oxide of iron,	0.43	0.19	0.25	0.11
Lime,	0.53	0.71	0.31	0.41
Magnesia,	trace.	0.02	trace.	trace.

Sudbury and Concord Rivers.

Similar to the Charles River water is that of the Sudbury River, or, as it is called after the junction with the Assabet, the Concord River.

The Sudbury rises in and flows through meadow lands, acquiring thereby in the late summer and fall a yellow, almost brown color. This color, the present year at least, has been more pronounced than in the case of Charles River, and on account of the thus far open winter the color has persisted longer than it sometimes does. The amount of organic matter, however, at the present writing (December 20) is much less than it was in September and October. As the Sudbury will be considered more fully with reference to its proposed use as a supply for Boston and suburbs, attention is simply called at this point to the results of chemical examination given in Tables IV. and IV*a*.

Below the point at which it is proposed to divert a portion of the water of the Sudbury for metropolitan use, the river passes through Saxonville, where there are woollen mills, and

in the town of Concord joins the Assabet. The Assabet is formed by the junction of various brooks which rise in Northborough and in adjoining towns; it flows through Hudson and Stow, and then into Concord.

The united stream bears the name of Concord, and flows between Bedford and Carlisle, then through Billerica and Lowell, in which latter town it joins the Merrimack. At Billerica there are somewhat extensive woollen mills, and at Lowell the water of the river is used to furnish power to several manufactories.

The "stations" chosen for the collection of water for chemical examination were as follows:—

A. *Above Ashland.*

B. *Below Ashland*, after the river has been joined by Cold Spring Brook, coming from Hopkinton.

C. *In Framingham*, just above the point where the water of the river has been diverted into Farm Pond.

D. *In Concord*, before the Assabet joins the Sudbury.

E. *In Concord*, below the junction of the Sudbury and Assabet.

F. *Billerica*, above the mills.

G. *Above Lowell*, at seven-arch bridge.

H. *In Lowell.*

TABLE IV. *Examination of Sudbury and Concord Rivers.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.
					Inorganic.	Organic and Volatile.	Total.	
181	1873—October 23,	Cold Spring Brook, Ashland,	0.0037	0.0177	2.92	3.12	6.04	0.36
199[1]	December 17,		0.0044	0.0131	2.88	1.52	4.40	0.24
156	September 22,	Sudbury River, above Ashland,	0.0067	0.0313	2.96	3.04	6.00	0.28
180	October 23,		0.0051	0.0184	2.80	4.28	7.08	0.40
198[2]	December 17,		0.0044	0.0141	3.40	1.32	4.72	0.24
155	September 22,	Below Ashland,	0.0067	0.0287	3.08	3.44	6.52	0.29
179	October 23,		0.0053	0.0254	2.56	3.76	6.32	0.36
200[3]	December 17,		0.0044	0.0113	2.88	1.60	4.48	0.24
154	September 22,		0.0060	0.0300	3.60	3.08	6.68	0.28
46	July 1,	Sudbury River, at Framingham,	0.0060	0.0140	3.60	1.90	5.50	0.32
153	September 23,		0.0047	0.0261	2.44	2.68	5.12	0.28
178	October 23,		0.0064	0.0247	2.80	4.40	7.20	0.44
201[4]	December 17,		0.0048	0.0127	3.08	1.92	5.00	0.24
49[5]	February 19,		0.0060	0.0207	2.48	1.80	4.28	–
59	July 9,	Sudbury River, at Concord,	0.0047	0.0173	4.00	2.20	6.20	0.28
60	9,		0.0044	0.0197	3.80	2.24	6.04	0.30
162	September 23,		0.0067	0.0247	3.00	2.92	5.92	0.32
61	July 9,	Assabet, at Concord,	0.0044	0.0204	2.96	2.00	4.96	0.32
62	9,		0.0051	0.0217	2.92	2.12	5.04	0.32
161	September 23,		0.0053	0.0227	2.84	2.28	5.12	0.30
63	July 9,	Concord River, at Concord,	0.0040	0.0188	2.64	2.40	5.04	0.26
64	9,		0.0040	0.0193	3.08	2.24	5.32	0.28

159	1873—September 23,	Concord River, at Concord,	0.0080	0.0271	3.08	2.44	5.52	0.34
160	23,		0.0067	0.0264	3.20	2.80	6.00	0.34
53	July 8,	Concord, above North Billerica,	0.0057	0.0173	3.00	1.60	4.60	0.36
54	8,	Concord, at North Billerica, just above the mills,	0.0040	0.0207	2.84	2.56	5.40	0.34
55	8,		0.0060	0.0187	2.60	2.20	4.80	–
118	1872—November 30,	Lowell, 7-arch Bridge,	0.0200	0.0500	–	–	2.60	0.30
56[6]	1873—July 8,		0.0063	0.0188	3.42	2.08	5.50	0.32
57[7]	8,		0.0065	0.0220	3.06	2.04	5.10	0.34
58[8]	8,		0.0066	0.0230	3.06	1.80	4.86	0.34
112[9]	September 8,		0.0081	0.0300	3.68	2.92	6.60	0.24
113[9]	8,		0.0081	0.0324	3.20	2.84	6.04	0.26
191	November 13,		0.0056	0.0253	3.96	2.28	6.24	0.38
72[10]	July 10,	Lowell, Church Street Bridge,	0.0047	0.0207	5.45	2.70	8.15	0.40
73[10]	10,		0.0047	0.0167	4.88	2.72	7.60	0.44
119	1872—November 30,	Merrimack Street Bridge,	0.0230	0.0430	–	–	5.10	0.34

[1] Oxygen 7.0 c.c. to the liter. [2] Oxygen 7.2 c.c. to the liter. [3] Oxygen 6.6 c.c. to the liter. [4] Oxygen 7.9 c.c. to the liter.

The determinations of oxygen in Nos. 199, 198, 200, 201 were made December 18, in the laboratory.

[5] Examination of water made by W. R. N. for the town of Brookline, February, 1873, and printed in the report of Messrs. Shedd and Sawyer, civil engineers, to the town meeting. [6] Right-hand arch, a little out of current. [7] Next arch, in the current. [8] Third arch, in the current.

[9] Taken at different parts of the stream. Oxygen 1.62 c.c. per liter. [10] Taken at different parts of the stream.

TABLE IV*a*. *Examination of Sudbury and Concord Rivers.* [Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water. Inorganic.	Organic and Volatile.	Total.	Chlorine.
181	1873—October 23, ...	Cold-Spring Brook, Ashland, .	0.0022	0.0103	1.70	1.82	3.52	0.21
199[1]	December 17, . . .		0.0026	0.0076	1.68	0.89	2.57	0.14
156	September 22, . . .	Sudbury River, above Ashland, .	0.0039	0.0183	1.73	1.77	3.50	0.16
180	October 23, ...		0.0030	0.0107	1.63	2.50	4.13	0.23
198[2]	December 17, . . .		0.0026	0.0082	1.98	0.77	2.75	0.14
155	September 22, . . .	Below Ashland, ...	0.0039	0.0168	1.80	2.01	3.81	0.17
179	October 23, ...		0.0031	0.0148	1.49	2.20	3.69	0.21
200[3]	December 17, . . .		0.0026	0.0066	1.68	0.93	2.61	0.14
154	September 22, . . .	Below Ashland, further down stream, ...	0.0035	0.0175	2.10	1.90	4.00	0.16
46	July 1, ...	Sudbury River at Framingham, .	0.0035	0.0080	2.10	1.11	3.21	0.19
153	September 23, . . .		0.0027	0.0152	1.42	1.57	2.99	0.16
178	October 23, ...		0.0037	0.0144	1.63	2.57	4.20	0.26
201[4]	December 17, . . .		0.0028	0.0074	1.80	1.12	2.92	0.14
49	February 19, . . .		0.0035	0.0121	1.45	1.05	2.50	–
59	July 9, ...	Sudbury, at Concord, . . .	0.0027	0.0101	2.34	1.28	3.62	0.16
60	9, ...		0.0026	0.0115	2.22	1.31	3.53	0.18
162	September 23, . . .		0.0039	0.0144	1.75	1.70	3.45	0.19
61	July 9, ...	Assabet, at Concord, . . .	0.0026	0.0119	1.73	1.17	2.90	0.19
62	9, ...		0.0030	0.0127	1.70	1.24	2.94	0.19
161	September 23, . . .		0.0031	0.0132	1.66	1.33	2.99	0.18
63	July 9, ...	Concord River, at Concord, . .	0.0023	0.0110	1.54	1.40	2.94	0.15

64	1873—July 9,	Concord River, at Concord,	0.0023	0.0113	1.80	1.31	3.11	0.16
159	September 23,		0.0047	0.0158	1.80	1.42	3.22	0.20
160	23,		0.0039	0.0154	1.87	1.63	3.50	0.20
53	July 8,	Concord, above North Billerica,	0.0033	0.0101	1.75	0.93	2.68	0.21
54	8,	Concord, at North Billerica, just above the mills,	0.0023	0.0121	1.66	1.49	3.15	0.20
55	8,		0.0035	0.0109	1.52	1.28	2.80	–
118	1872—November 30,	Concord River, at 7-arch Bridge, Lowell,	0.0117	0.0233	–	–	1.52	0.18
56	1873—July 8,		0.0037	0.0110	2.00	1.21	3.21	0.19
57	8,		0.0038	0.0128	1.79	1.19	2.98	0.20
58	8,		0.0039	0.0134	1.79	1.05	2.84	0.20
112	September 8,		0.0047	0.0175	2.15	1.70	3.85	0.14
113	8,		0.0047	0.0189	1.87	1.66	3.53	0.15
191	November 13,		0.0033	0.0148	2.31	1.33	3.64	0.22
72	July 10,	Church Street Bridge, Lowell,	0.0027	0.0121	3.18	1.58	4.76	0.23
73	10,		0.0027	0.0097	2.85	1.59	4.44	0.26
119	1872—November 30,	Merrimack Street Bridge Lowell,	0.0134	0.0250	–	–	2.98	0.20

[1] Oxygen 1.62 cubic inch to the gallon. [2] Oxygen 1.66 cubic inch to the gallon. [3] Oxygen 1.52 cubic inch to the gallon. [4] Oxygen 1.82 cubic inch to the gallon.

The determinations of oxygen in Nos. 199, 198, 200, 201 were made on December 18, in the laboratory.

The flow of the Sudbury River at Framingham has been estimated, from its drainage area, to be about 40,000,000 gallons daily, or about sixty-three cubic feet per second. As to the flow of the Concord, something has already been said on page 80.

From the results of the chemical examinations of the rivers which have been under consideration the present year, it appears that no one of them, with the exception of the Blackstone, can be called foul. This river is foul in the upper part of its course, although, for the present, the dilution of the polluted stream with water less polluted than its own, preserves the lower portion of the stream in a tolerably good condition.

The Charles, Sudbury, Assabet, and Concord rivers are very different in character from the Merrimack or the Blackstone. Formed as they are by brooks which rise in meadowland, and flowing as they do through meadows and marshes, the waters are characterized, especially in the late summer and fall, by the presence, in solution, of a considerable amount of vegetable matter, which gives the water a yellow or brown color, already alluded to. These rivers are usually very clear, and although rendered somewhat turbid by heavy rains do not show such marked changes, with respect to the suspended matter, as are exhibited by the Merrimack. As yet these streams are not made, to any extent, the carriers of sewage in the upper part of their flow; allusion has already been made to their receiving sewage and manufacturing refuse near their mouths.

Neponset River.

The Neponset River is similar in character to the streams last considered. It receives some manufacturing refuse, and, at the lower part of its course, it is made the receptacle of sewage. A single examination of the water has been made at Readville, and one below Hyde Park. The result of the chemical examination was as follows :—

	Parts per 100,000.		Grains per Gallon.	
	At Readville.	Below Hyde Park.	At Readville.	Below Hyde Park.
Ammonia, ...	0.0047	0.0110	0.0027	0.0064
"Albuminoid ammonia," . .	0.0270	0.0300	0.0158	0.0175
Mineral, ...	2.40	3.60	1.40	2.10
Organic and volatile, . . .	3.40	3.04	1.98	1.77
Total solid residue, . . .	5.80	6.64	3.38	3.87
Chlorine, ...	0.50	0.52	0.29	0.30

On Rivers as a Source of Water-Supply.

In the preceding pages an account has been given of the results obtained from the examination of water from certain of our running streams. We are naturally led to consider the bearing of the facts observed on the question of the use of rivers as a source of supply of water for domestic purposes. The matter was, to some extent, discussed in the report made to the Board last year, and I desire to repeat and emphasize the statements made at that time. The order of the legislature, in accordance with which this investigation was begun, alluded to the "joint use of water-courses for sewers and as sources of supply for domestic use." I believe that all such joint use is to be deprecated, and because of the very great difficulty, I might say impossibility, of preventing the use of running-streams as sewers to a certain extent, their use as sources of domestic supply, at least at such portion of their course as lies below thickly settled and manufacturing towns, is not to be advised. For this reason, in a previous report, the great ponds of the Commonwealth have been looked to as affording a better source of supply. It is, however, to be borne in mind that the objection is not to the river as such. A river may, considered by itself, afford a most excellent, a perfectly unobjectionable, supply of water. Its sources may be clear and pure mountain-streams; it may flow over a rocky or gravelly bed, uncontaminated by refuse from the habitations and factories of men, and free, or nearly so, from vegetable matter; it may be so situated that no liquid refuse finds its way to it, without being first purified by filtration through a sufficient amount of natural soil. In this case no objection

can be made to using the water for all domestic purposes. On the other hand, a pond or lake may be, in itself, a very objectionable source of supply, especially if so situated as to receive direct drainage, or if fed by streams which are used as sewers. It is an indispensable condition in the choice of any stream or lake as a source of water-supply, that the source should not only be free from actual present contamination, but should also be so situated as to render it possible to protect it from contamination in the future. A striking instance of the danger to which a lake used as a source of water-supply may be exposed, is afforded by Mystic Lake, which will presently be alluded to more fully.

It is very far from being my desire to awaken unnecessary anxiety in any mind with reference to the desired purity of our sources of water-supply. It is very true that a large amount of refuse material is of such a character as to be, except in excessive quantities, of no appreciable influence on the human system; the addition of the inorganic compounds of lime, soda, potash, etc., would have no deleterious effect; in fact, although the lime-compounds increase the hardness of water and make it less desirable for washing, the presence of a moderate amount of mineral substances makes the water more palatable, and, very probably also, more wholesome.* Then in the case of many waste liquors which appear to be very offensive, the matter which really could be regarded as injurious is comparatively small in amount. If we consider the character of the substances discharged by different manufacturing establishments, we shall find them very different; some of them are such as to be universally regarded as unfit to admit to any stream,—those, for instance, containing lead, arsenic, etc.; others, such as salts of iron, are scarcely regarded as injurious: thus, the discharge of sulphate of iron

* It is well known that freshly-distilled water is very insipid. This is in part owing to its freedom from dissolved gases, but partly also to the absence of mineral salts. On shipboard the water is aërated before being used to drink, and it has been proposed to render it more palatable and more wholesome by the addition of a certain amount of mineral salts. A mixture which has been proposed for this purpose consists, for 1,000 liters of water, of 4.8 grams salt, 3.4 grams sulphate of soda, 48 grams bicarbonate of lime [? W. R. N.], 14 grams carbonate of soda, and 6 grams carbonate of magnesia. It is stated that the Russian navy has adopted this idea, and furnished to its vessels a mixture of this character.—*Fonssagrives. Hygiène et assainissement des Villes. Paris,* 1874, *page* 316.

(copperas) into a stream already polluted with sewage-matter, might, within certain limits, be of positive advantage (see last Report of the Board of Health, pages 97–98). Again, in the case of some of the vegetable dyestuffs, the weak, spent dye-liquors, although they communicate a very foul appearance to the water for some distance, yet contain a comparatively small amount of solid matter, and, if discharged into a stream of considerable size, are soon disseminated through it, and diluted to a very great extent.

Much depends, of course, upon the size of the stream into which the refuse is thrown. Thus, while into the Merrimack at Lowell, even during the summer, it would be necessary to throw more than 100 tons of solid matter daily in order to increase the amount in the water by one grain to the gallon, another and smaller stream might be hopelessly fouled by a single factory.

Different in character, however, from much of the refuse of manufacturing establishments is the sewage coming from our dwellings, or the sewage (in its more restricted sense, of excremental matter from animal sources) which comes from our factories. In fact, this foul material coming from establishments employing a large number of operatives, is likely, in many cases, to have a more injurious effect upon the stream into which it is thrown, than the refuse from the manufacturing operations. There are, however, some branches of industry which discharge refuse material, offensive and dangerous to health; such material is discharged from tanneries, wool-pulling and hide-dressing establishments, slaughter-houses and rendering-houses. Too much stress cannot be laid upon the importance of preventing the discharge of such refuse, and of sewage in its more restricted sense, into any stream or pond used, or likely to be used, as a source of water-supply.

The importance of this matter is underrated for two reasons: first, because of the oft-repeated assertion, made on the authority of Dr. Letheby, that "if sewage-matter be mixed with twenty times its bulk of ordinary river-water, and flow a dozen miles, there is not a particle of that sewage to be discovered by chemical means"; secondly, because of the feeling that to be in any way prejudicial to health, a water

must contain enough animal matter to be recognized readily by chemical tests,—enough, in fact, to be expressed in figures.

The first of these opinions has been disproved by the experiments of the Rivers Commission, in England, who have shown that not only is a flow of twelve miles insufficient to destroy the organic matter of sewage when mixed with water in the above proportion, but also a flow of one hundred and sixty miles is far from sufficing for that purpose. When sewage is mixed with water, some of its constituents begin to decompose very soon. The urea, for example, is quickly converted into carbonate of ammonium; others of the constituents, however, are less ready to begin to decompose, and when decomposition does set in, although some of the substances may undergo chemical change, there still remain organic nitrogenous compounds in the mixture, and these substances are swept along by the rivers, even to the sea.

The carcass of a dead animal thown into a river or into a pond, and confined there so as not to be borne off bodily, gradually wastes away and in a longer or shorter time the main part of the carcass has disappeared. What has become of it? A part has been converted into gaseous products of decomposition as the offensive odors observed during the decay will testify, but another portion has been carried off by the stream as soluble nitrogenous organic matter. This nitrogenous matter would be detected a short distance away with greater or less ease according to the volume of water present, and in a stream of large size or in a lake, at no very great distance from the source of contamination, it would be impossible to discover any offensive matter. There is a limit to the delicacy of our tests; there is a point beyond which, at the present, we are not able to go. At the present time a chemical analysis *alone* is not sufficient to determine the desirability of a given water-supply. The rice-water evacuations of a cholera patient diluted with no very large amount of water would form a liquid in which chemical tests would fail to indicate the presence of anything which could be pronounced injurious, and yet there is no destruction of the poisonous material; it is still in the liquid, although not to be recognized, and such water is now regarded by physicians as

the most direct and certain vehicle for the transmission of Asiatic cholera.

The second opinion is that sewage, if diluted to a very considerable extent, becomes innocuous; this opinion, which involves questions belonging to the physician rather than to the chemist, is very likely to be carried too far. I do not know that we have any proof that perfectly fresh sewage (the term being used in its more restricted sense) coming from healthy persons, when mixed with water, is injurious if drank; it would probably not be asserted that such a mixture was actually good to drink,—it would certainly be opposed to our instinctive ideas. It is true that fish are not destroyed by even a considerable discharge of fresh sewage into a stream. We do know, however, that sewage which has begun to undergo decomposition is unwholesome; such decomposing sewage has been observed to destroy and drive away the fish from the stream in the immediate neighborhood of the point of discharge, and there are a great number of instances on record where cases of sickness have been traced directly to the fact that the water used for drinking was rendered foul by the decomposing excremental matter which found its way into the source of supply; and drinking-water, polluted by even an infinitesimal amount of excremental matter coming from those suffering from typhoid fever is now very generally held to be capable of propagating that disease.

It has already been stated that sewage-matter itself is not completely destroyed when it is introduced into a running stream, and is borne along even for many miles; we must suppose, and indeed have every reason to believe, that in the case of sewage which when *fresh* is capable of communicating disease, the destruction of the peculiar organized matter which has the specific effect must be more slow even than the unorganized effete matter which forms the mass of the dissolved and suspended solid matter of ordinary sewage. In the case of certain diseases, which have been shown by experiment to owe their origin to the presence of distinct and recognizable living organisms it has been found that these organisms retain their vitality in spite of very varied conditions, and through very considerable changes of temperature.

One would not assert that the drainage from a single house

would contaminate the water of a large river like the Merrimack so as to make it unfit for domestic use, yet we must be beware how we depreciate the effect of sewage-matter, even in a large stream. While, with a small amount of sewage, the chances are as favorable as possible for the action of atmospheric influences, and the chances of taking up any undecomposed particle of material, capable of propagating disease, are rendered proportionally small owing to the great dilution, it is to be borne in mind that the action of such matter on the system is not regarded as *cumulative*. A minute quantity may do much harm, because it is now generally believed that it may hold the specific thing which propagates specific diseases. In the case of certain organic poisons which affect the system through the blood, the experiments of M. Chauveau and of Dr. Burdon-Sanderson on vaccine matter render it well-nigh certain that no amount of dilution can destroy the power of infection which these poisons possess. From these experiments, it appears that if inoculation be performed with vaccine lymph after it has been very much diluted, the chance of the formation of pustules is rendered less, but when the vaccination is successful, the pustule formed presents its normal features and passes through the usual stages of development.

Let us consider for a moment the condition of the Blackstone River. No one could be found who would drink the water of Mill Brook; no one probably who would drink the water of the Blackstone at the bridge below Quinsigamond Village, Worcester. When, then, does the water become potable? I do not believe it becomes potable at all, or that it is in its course ever free from the contamination it receives above. The water is, however, sometimes drank at Blackstone and below, and was proposed at one time as an available supply for the city of Providence, R. I.

It has been objected that it would be impossible to obtain water perfectly pure, and that it is very questionable whether perfectly pure water would really be as wholesome as water containing a certain amount of foreign substances (see note on page 104). It may be very true that we cannot procure absolutely pure water; we may not even be able to procure water absolutely free from such substances as we regard as injurious; but there are some causes of contamination which

must, at any cost, be avoided, and in other respects the water must be obtained, as nearly as possible, of the ideal excellence. We know that there are many persons who live and seem to get along very well in utter disregard of the laws of health, as far as personal cleanliness, diet, pure air and many other things are concerned; but because many thus live for a time without experiencing evident inconvenience, does any one argue that purity of air, a healthful diet, and cleanliness of person, are not to be recommended and sought after? The effect upon the community of the bolting of indigestible food must be immense, but comparatively few are the acknowledged cases of injurious effects. We are able, however, in many cases, to show even in these matters that the apparent strength and immunity from discomfort is due to a constitution naturally strong, and the draught upon the vital energy may be seen, if not in the persons themselves in later years, at least in their children.

In fact, to isolate the effects of various habits, which, from a hygienic stand-point, are decidedly bad, is a problem which, in many cases, it is impossible to solve, and yet that disease does come from the use of an inferior water-supply is abundantly proved by many instances which are on record, where a disease, such as diarrhœa, dysentery, cholera or typhoid fever, which had affected an entire community, has been checked by a change in the source of drinking-water; and on a still larger scale there are instances where the benefits derived from the change to a better water-supply have been marked by a decreased death-rate. In such cases it is difficult to point to the exact thing which has produced the bad effects, but in some cases the presence of a comparatively large amount of organic matter, derived from animal sources, has been the only circumstance to which chemical examination could point as a probable cause.

It is also, as has already been said, well established that particular forms of disease may be and are transmitted by drainage into wells and other sources of water-supply, and it is impossible to say how little foul matter is needed to work evil effects. A case, or several cases of typhoid fever in a family, leads to the discovery that the well from which the drinking-water is taken, is in underground but direct commu-

nication with the vault or cesspool; but the effect upon the system during the time when the well was deteriorating, during the time that the sewage material was gradually wearing a channel to the well, the point of time when the well *began to be* impure, these things were not, could not be noticed.

While for many of the purposes of the household a water unfit for drinking might not be objectionable, we are still obliged to provide for the most exacting of its uses. The time may come when it will be necessary to supply our drinking-water from some sedulously guarded but limited source of supply, and to furnish for manufacturing uses, for the extinguishing of fires, and for the carrier of waste material, a water of poorer quality but abundant in quantity. The amount of water which we drink is very small compared with that used for other purposes. It is to be hoped and expected that before such necessity arises, it will not only be possible, but financially profitable, to dispose of the refuse materials in other ways than by running them into the water-courses.

Such division of the water-supply is carried out to a certain extent in some places. Paris, for instance, draws its water-supply from various sources, among others from the highly polluted Seine. It has been proposed to reserve for domestic uses a supply drawn from purer sources, and to devote the more impure waters to public uses, such as the supplying the fountains of the various parks, the cleansing of the streets, and the extinguishing of fires. At present, however, the plan is only partly carried out, and much of the water drank is entirely unfit for such use.

While the chief objection to rivers as sources of water-supply lies in the fact that they are almost of necessity converted to a greater or less extent into carriers of sewage, it is to be noted that there is a great difference between various streams in their natural conditions, and while a stream like the Merrimack would, from the nature of its water-shed, be well fitted for use, other streams, such as the Charles and the Sudbury or Concord, are much less desirable on account of the soluble vegetable matter which communicates some disagreeable color and taste. This vegetable matter is generally considered as harmless; it no doubt does not have as injurious

an effect as sewage-matter, and yet many persons are affected by it. Experience has shown that waters may be freed from much of this color, by storage in reservoirs or ponds exposed to the sun and air.

THE PRESENT CONDITION OF THE WATER-SUPPLY OF CERTAIN CITIES IN MASSACHUSETTS.

By what has already been said in the last Annual Report of the Board, and in the preceding pages of the Report, attention is called to the necessity of carefully protecting our lakes and great ponds from defilement, on the ground of the close dependence of the present and future health of the crowded cities and towns of Massachusetts upon the preservation of these reservoirs of pure water for domestic purposes.*

Attention has been further called† to the special danger threatening the water-supply of Boston (Lake Cochituate), and of East Boston, Charlestown, Chelsea and Somerville (Mystic Lake), and it has been thought best by the Board to institute a direct inquiry into the present condition of the water-supply derived from these sources and the prospects for the future.

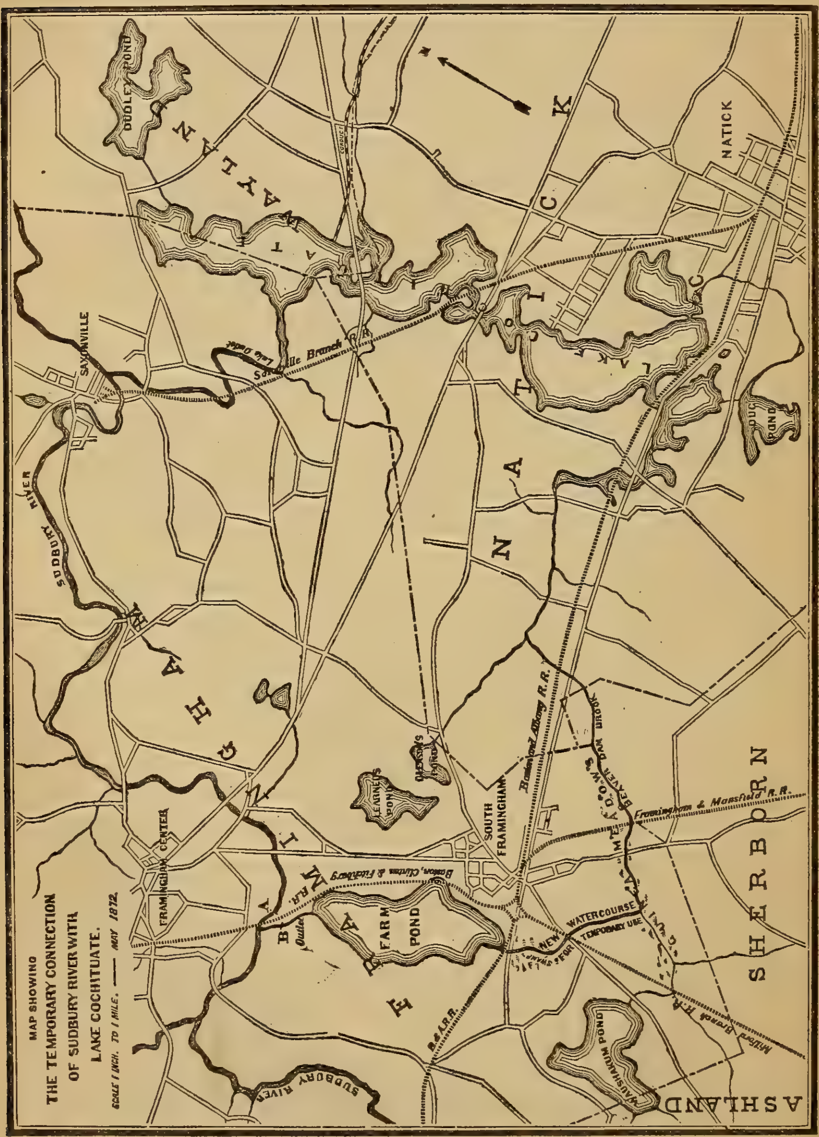
Cochituate.—It had been noticed that the water, as delivered in the city, possessed more color than formerly, and, although the analyses made at different times differed considerably from each other, yet it seemed that the relative proportion of organic matter had increased.

An examination has been made during the present year of the sources of supply of the lake, and water taken from different points and at different times has been submitted to chemical investigation. The water, as delivered in Boston, has also been the subject of examination at more or less frequent intervals.

Cochituate Lake is situated in Middlesex County, in the towns of Natick, Framingham and Wayland. It virtually consists of three lakes or ponds connected together, and is about three and a half miles in length. The banks of the lake in the main are sandy or gravelly, and the water has been of very great purity. The accompanying map will show

* See Fourth Annual Report of the Massachusetts State Board of Health, p. 11.
† Id., p. 105.

with sufficient accuracy the general features of the lake, and the position of the various streams and ponds which contribute to the supply of water :—



Dug Pond was at the first connected with the lake by a culvert; Dudley Pond was connected in 1861–62. The water

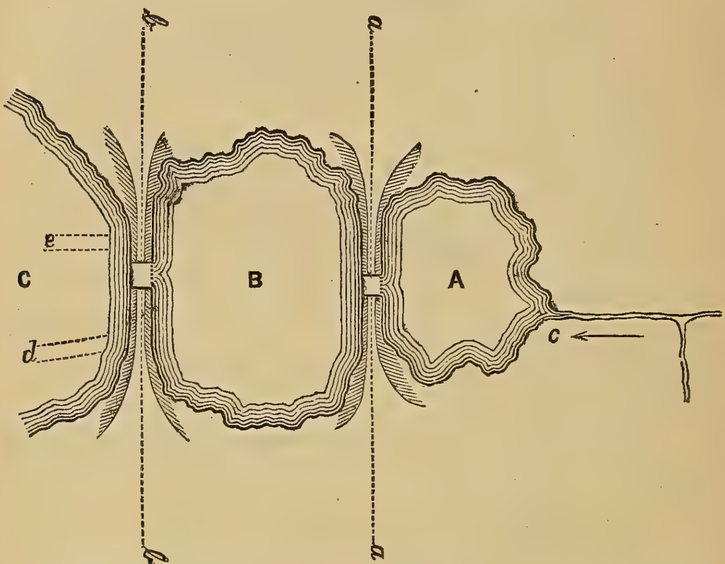
in both these ponds is good. A stream of considerable size, Snake Brook, enters the lake near the gate-house. It receives no sensible contamination, although at certain times the water has some considerable color, owing to the meadow-land through which it flows. Beaver Dam Brook serves to connect Farm Pond with the lake. The water taken during the year 1872 from the Sudbury River was let into Farm Pond, and it flowed thence to Cochituate. On the map the point where the dam for diverting the river-water was built is indicated by the letter A.

The only stream which, at the present time, brings down any considerable amount of impurity into the lake is a brook called Pegan's Brook, which flows through the centre of the town of Natick, receiving drainage from dwellings on its bank, and also from several factories.

The report of the Cochituate Water Board for the year 1864 alludes to the fact that this brook receives much offensive matter, and in order to intercept it as much as possible, the following plan was adopted, namely: "To build across the meadow, which is from 80 to 100 feet wide at the mouth of the brook, a dam of such materials that the waters of the brook, under a slight head, should filter through, thus arresting much of the filth which would otherwise pass into the lake. A plan was proposed for a dam to be built of common field-stone, except a place three feet in width in the centre of the embankment, extending its whole length, to be filled with fine pebbles or screened gravel, which may be replaced whenever the filter becomes foul or clogged, without disturbing the rest of the dam. To provide for unusual flows of water, as in the case of spring freshets, a flume five feet in width, provided with stop-planks, was to be built through the dam." This plan was carried out originally as a temporary expedient, and a route was surveyed for diverting the waters of the brook to Bannister's Brook, which empties into Sudbury River below the point where connection is made with Farm Pond. As this would require the construction of an aqueduct two and a half miles long, and involve an expense of $70,000, it was felt that the work should not be undertaken except in the event of absolute necessity. The dam was rebuilt in 1867, and a second one, inside of the first,

and some eighty feet distant, was built in 1870. The arrangement of these filter-dams may be seen on the accompanying plan, which is intended merely to give an idea of relative position, and is not drawn to scale.

FILTER-DAMS AT MOUTH OF PEGAN BROOK.



a a, *b b*, represent the dams. A, B, are the settling-basins. C is a portion of the lake.

Pegan Brook is joined by another brook in the meadow, but the waters of this brook are usually diverted into Dug Pond.

In this connection it may be further stated that outside of the filter-dams, at some distance from them, the waters of the arm of the lake, into which Pegan Brook enters, are in part cut off from the rest of the lake by a bar of gravel which extends from shore to shore, as indicated in the map on page 112, where also may be seen the relative position of the mouth of Pegan Brook (indicated by the letter C) with reference to the lake. There is through this gravel-bar a channel, the width of which varies with the height of the water; when the water of the lake is four feet below high water the channel is about thirty feet wide.

With regard to the efficiency of the means thus adopted for preventing the entrance into the lake of the offensive

matters brought down into the settling-basins: At the time of a visit to the lake, made May 16, 1873, there was a considerable amount of water flowing in the brook; the presence of a large number of broken and useless household utensils along the banks, and the decaying carcass of a cat lying in the stream and making the air in the immediate vicinity offensive, showed that the brook was regarded as a natural receptacle for rubbish. The water in both the settling-basins was somewhat turbid and disagreeable to look upon. Outside of the outer embankment the water was somewhat clearer. At this time the water in the lake was at high-water mark, and the water inside the outer embankment was about two feet above the water of the lake. Samples of water taken at the flume inside the inner embankment and outside the outer embankment, showed that, as far as the dissolved impurities were concerned, no amelioration was effected. Subsequent examinations were made at various times during the latter part of the year. The results of the chemical examinations may be found in Tables V. and V *a*.

On the occasion of personal visits made on July 16 and 21, after a considerable period of dry weather, the stream was found to contain a rather small amount of clear and apparently inoffensive water. The hat-factory, the discharge from which on some occasions causes the water of the brook to be almost black, was not in operation at that time. The water in the first settling-basin contained a large amount of confervæ, so as to be green and opaque in appearance; the second basin was of the same green color at the upper end; towards the lake it was turbid, but the turbidity was more of a clayey color. At this time the water in the lake was some three feet below high-water mark, and the whole of the outer face of the outer embankment was dry. The water within the embankment stood two feet or more higher than on the outside. From the southern end of the embankment issued a small, clear stream (*d*, p. 114), about equal in size to that which entered the upper basin, and, as appeared on chemical examination, even more impure, owing, no doubt, to the fact of its carrying off a portion of the matter which had previously collected in the basins. There is no doubt that the filter-dams may and do arrest and retain a considerable amount of

TABLE V. *Examination of Cochituate Lake and its Sources of Supply.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Unfiltered Water.			Solid Residue of Filtered Water.			Chlorine.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.	
		Pegan Brook.									
11	1873—May 26,	At end of covered conduit,	0.1740	0.0350	–	–	–	9.50	6.60	16.10	2.40
87	August 28,		0.0736	0.0100	–	–	–	12.84	5.24	18.08	1.84
75	July 16,	Just before entering settling-basin,	0.0350	0.0162	–	–	–	16.20	5.60	21.80	3.10
88	August 28,		0.0540	0.0136	–	–	–	17.40	5.28	22.68	2.64
204	December 17,		0.0250	0.0087	–	–	–	11.24	3.60	14.84	1.84
4	May 16,	From first settling-basin,	0.0188	0.0364	–	–	–	3.90	4.40	8.30	2.25
10	26,		0.2171	0.0542	–	–	–	13.50	12.20	25.70	2.80
41	July 1,		0.1100	0.0200	–	–	25.60	12.90	5.40	18.30	2.92
76	16,		0.0270	0.0430	–	–	–	14.32	2.76	17.08	3.04
9	May 26,	From second settling-basin. Inside of outer embankment,	0.1656	0.0627	–	–	–	12.70	10.20	22.90	2.80
77	July 16,		0.1120	0.0347	–	–	–	14.80	2.28	17.08	3.26
3	May 16,	From outside of outer embankment,	0.0436	0.0365	–	–	–	8.20	9.00	17.20	1.25
8	26,		0.0528	0.0799	–	–	–	4.90	2.30	7.20	0.70
42	July 1,		0.0275	0.0231	–	–	14.00	7.40	1.20	8.60	1.50
78	16,	From brook issuing from southern end of outer embankment,[1]	0.1000	0.0230	–	–	–	14.40	2.52	16.92	3.32
89	August 28,		0.0070	0.0450	15.60	6.36	21.96	14.80	5.20	20.00	2.64
203	December 17,		0.0193	0.0060	–	–	–	12.64	1.60	14.24	2.00
90	August 28,	From brook issuing from centre,[2]	0.0120	0.0240	–	–	–	14.16	5.12	19.28	2.68

		Cochituate Lake.									
43	1873—July 1,	From channel in bar (see description),	0.0127	0.0320	–	–	9.20	5.00	2.30	7.30	0.66
79	16,		0.0080	0.0250	–	–	–	3.80	3.32	7.12	0.76
96	August 29,		0.0067	0.0188	–	–	–	4.40	2.80	7.20	0.44
202	December 17,		0.0160	0.0093	–	–	–	7.00	2.60	9.60	1.04
5	May 16,	Bridge over Saxonville Branch Railroad,	–	0.0234	–	–	–	–	–	4.40	0.40
12	26,		0.0160	0.0360	–	–	–	–	–	4.50	0.40
80	July 16,		0.0040	0.0127	–	–	–	2.28	1.76	4.04	0.40
91	August 29,		0.0033	0.0208	–	–	–	3.24	3.36	6.60	0.38
14	May 26,	Bridge near gate-house,	0.0160	0.0240	–	–	–	2.00	2.20	4.20	0.35
92	August 29,		0.0045	0.0153	–	–	–	2.40	1.88	4.28	0.26
13	May 26,	At gate-house,	0.0140	0.0390	–	–	–	1.40	2.20	3.60	0.35
93	August 29,		0.0033	0.0103	–	–	–	2.92	1.72	4.64	0.28
94	29,	Inlet from Dudley Pond,	0.0051	0.0193	–	–	–	2.84	1.80	4.64	0.24
6	May 16,	Snake Brook,	0.0016	0.0152	–	–	–	1.90	3.30	5.20	0.35
95	August 29,		0.0027	0.0140	–	–	–	4.68	1.64	6.32	0.28
44	July 1,	Beaver Dam Brook,	0.0074	0.0193	–	–	–	4.50	3.00	7.50	0.36
45	1,	Outlet of Farm Pond,	0.0096	0.0133	–	–	–	5.70	0.70	6.40	0.38
–	June 30,	Boston. Laboratory of the Massachusetts Institute of Technology,	–	0.0149	–	–	–	2.20	2.30	4.50	0.32
–	July 4,		0.0033	0.0120	–	–	–	2.84	2.80	5.64	0.34
–	September 6,		0.0040	0.0120	–	–	–	2.76	2.06	4.82	0.30
–	15,		0.0033	0.0120	–	–	–	2.40	1.90	4.30	0.31
–	October 6,		0.0033	0.0120	–	–	–	3.24	1.96	5.20	0.34
–	25,		0.0034	0.0080	–	–	–	2.36	2.40	4.76	0.32
–	November 15,		0.0033	0.0132	–	–	–	3.00	2.00	5.00	0.30
–	December 19,		0.0037	0.0100	–	–	–	3.32	1.28	4.60	0.34

[1] See *d*, p. 114. [2] See *e*, p. 114.

TABLE V *a*. *Examination of Cochituate Lake and its Sources of Supply.* [Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Unfiltered Water.			Solid Residue of Filtered Water.			Chlorine.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.	
		Pegan Brook.									
11	1873—May 26,	At end of covered conduit,	0.1018	0.0204	–	–	–	5.54	3.85	9.39	1.40
87	August 28,	At end of covered conduit,	0.0430	0.0058	–	–	–	7.49	3.06	10.55	1.07
75	July 16,	Just before entering settling-basin,	0.0204	0.0094	–	–	–	9.43	3.27	12.70	1.81
88	August 28,	Just before entering settling-basin,	0.0315	0.0079	–	–	–	10.16	3.08	13.26	1.54
204	December 17,	Just before entering settling-basin,	0.0146	0.0051	–	–	–	6.56	2.10	8.66	1.07
4	May 16,	From first settling-basin,	0.0110	0.0212	–	–	–	2.28	2.57	5.85	1.31
10	26,	From first settling-basin,	0.1267	0.0316	–	–	–	7.88	7.12	15.00	1.63
41	July 1,	From first settling-basin,	0.0642	0.0117	–	–	14.94	7.53	3.15	10.68	1.70
76	16,	From first settling-basin,	0.0158	0.0251	–	–	–	8.36	1.61	9.97	1.77
9	May 26,	From second settling-basin. Inside of outer embankment,	0.0969	0.0366	–	–	–	7.41	5.95	13.36	1.63
77	July 16,	From second settling-basin. Inside of outer embankment,	0.0654	0.0203	–	–	–	8.64	1.33	9.97	1.90
3	May 16,	From outside of outer embankment,	0.0255	0.0213	–	–	–	4.79	5.25	10.04	0.73
8	26,	From outside of outer embankment,	0.0308	0.0466	–	–	–	2.86	1.34	4.20	0.41
42	July 1,	From outside of outer embankment,	0.0160	0.0135	–	–	8.17	4.32	0.70	5.02	0.88
78	16,	From brook issuing from southern end of outer embankment,[1]	0.0584	0.0134	–	–	–	8.40	1.47	9.87	1.94
89	August 28,	From brook issuing from southern end of outer embankment,[1]	0.0041	0.0262	9.11	3.71	12.82	8.64	3.04	11.68	1.54
203	December 17,	From brook issuing from southern end of outer embankment,[1]	0.0113	0.0035	–	–	–	7.38	0.93	8.31	1.17
90	August 28,	From brook issuing from centre,[2]	0.0070	0.0140	–	–	–	8.26	2.99	11.25	1.56

		Cochituate Lake.									
43	1873—July 1,	From channel in bar (see	0.0074	0.0187	–	–	–	2.92	1.34	4.26	0.39
79	16,	description),	0.0047	0.0146	–	–	–	2.22	1.94	4.16	0.44
96	August 29,		0.0039	0.0110	–	–	–	2.57	1.63	4.20	0.26
202	December 17,		0.0093	0.0054	–	–	–	4.09	1.52	5.61	0.61
5	May 16,	Bridge over Saxonville	–	0.0137	–	–	–	–	–	2.57	0.23
12	26,	Branch Railroad,	0.0093	0.0210	–	–	–	–	–	2.62	0.23
80	July 16,		0.0023	0.0074	–	–	–	1.33	1.03	2.36	0.23
91	August 29,		0.0019	0.0121	–	–	–	1.89	1.96	3.85	0.22
14	May 26,	Bridge near gate-house,	0.0093	0.0140	–	–	–	1.17	1.28	2.45	0.20
92	August 29,		0.0026	0.0089	–	–	–	1.40	1.10	2.50	0.15
13	May 26,	At gate-house,	0.0082	0.0228	–	–	–	0.82	1.28	2.10	0.20
93	August 29,		0.0019	0.0103	–	–	–	1.70	1.00	2.70	0.16
94	29,	Inlet from Dudley Pond,	0.0030	0.0117	–	–	–	1.66	1.05	2.71	0.14
6	May 16,	Snake Brook,	0.0009	0.0089	–	–	–	1.11	1.92	3.03	0.20
95	August 29,		0.0016	0.0082	–	–	–	2.73	0.96	3.69	0.16
44	July 1,	Beaver Dam Brook,	0.0043	0.0113	–	–	–	2.63	1.75	4.38	0.21
45	1,	Outlet of Farm Pond,	0.0056	0.0078	–	–	–	3.33	0.41	3.74	0.22
–	June 30,	Boston. Laboratory of	–	0.0087	–	–	–	1.28	1.34	2.62	0.19
–	July 4,	the Massachusetts In-	0.0019	0.0070	–	–	–	1.66	1.63	3.29	0.20
–	September 6,	stitute of Technology,	0.0023	0.0070	–	–	–	1.61	1.20	2.81	0.16
–	15,		0.0019	0.0070	–	–	–	1.40	1.11	2.51	0.18
–	October 6,		0.0019	0.0070	–	–	–	1.89	1.14	3.03	0.20
–	25,		0.0020	0.0047	–	–	–	1.38	1.40	2.78	0.19
–	November 15,		0.0019	0.0077	–	–	–	1.75	1.17	2.92	0.17
–	December 19,		0.0022	0.0058	–	–	–	1.94	0.75	2.69	0.20

[1] See *d*, p. 114. [2] See *e*, p. 114.

filth which would otherwise find its way into the lake. The filth retained, however, is matter which is insoluble, and the deposit has to be removed occasionally; the effect on the dissolved organic material is so extremely slight as to be of almost no account. This is, to be sure, what would be expected *a priori*, as filtration through a bed of gravel or sand saturated with water, and kept in such condition, could not be expected to remove the organic matter in solution.

It is to be observed that the examination made in December showed more satisfactory results, although in this case the character of the organic matter was very objectionable. At this time, also, the amount of dissolved oxygen was much greater than in the summer, as will be seen on the following page. It will be observed also that, at this time, the effect of the brook upon the water at the bar was greater than at the time of previous examinations.

The heights of the water in the lake at the time the samples were taken, were as follows, according to figures kindly furnished by Mr. D. Fitzgerald, Superintendent of the Western Division :—

	Above bottom of Aqueduct.	Below High-Water Mark.
May 12,	13ft. 4 in.	0
16,	13 1½	0ft. 2½ in.
July 1,	11 1½	2 3
16,	10 2½	3 1½
Aug. 28,	8 8½	4 7½
Dec. 17,	9 4	4 0

On August 29, determinations were made on the spot of the amount of oxygen dissolved in the water, with the following results :—

	Oxygen.	
	In cubic centimeters to the liter.	In cubic inches to the gallon.
Pegan Brook, just before entering the first settling-basin, ...	1.91	0.44
First settling-basin, lower end, . . .	1.06	0.24
Second settling-basin, upper end, . . .	1.49	0.34
Second settling-basin, lower end, . . .	1.66	0.38
Brook issuing from southern end (*d*, p. 114),	1.42	0.33
Brook issuing at centre (*e*, p. 114), . .	1.31	0.30
Lake at outer bar, ...	3.78	0.87

On December 18 determinations were made of the amount of oxygen contained in the water of Pegan Brook, the stream issuing from the dam, and of the water in the lake. The waters were taken on December 17 at noon, and at that time were of a temperature not far from the freezing-point. The bottles in which they were taken were not opened until the succeeding morning. The oxygen was then determined, the waters being of the temperature in each case as indicated below:—

Number.	Locality.	Temperature in centigrade degrees.	Oxygen in cubic centimeters to liter.	Temperature in Fahrenheit degrees.	Oxygen in cubic inches to the gallon.
204	Pegan Brook, ...	16°	7.8	61°	1.80
203	Stream issuing from dam, .	16°	7.5	61°	1.73
202	Lake, channel in bar, . .	16°	6.6	61°	1.52

This being the state of things with regard to Pegan Brook, the question immediately arises, Does the impurity thus entering the lake have any actual effect on the water, as regards its use for domestic purposes? I think we are safe in believing that, at the present moment, there is nothing in the condition of the water, or in its effect upon the systems of those who drink it, which can be charged to Pegan Brook. A glance at the map, or at the lake itself, shows the enormous

extent to which this impurity would be diluted, even supposing that it reached the consumer unchanged; but the progress of the water from this extreme end of the lake to the gate-house must be exceedingly slow, so that the opportunity for the chemical changes which affect the organic impurities of natural waters, when exposed to the light of the sun and to the oxygen of the air, is as favorable as it could well be. At any rate, the means of analysis at present at our command are insufficient to give us more than a slight suspicion of the presence of animal matter. On page 123 are collected together some of the previously published partial analyses of Cochituate water. As has been stated above, a general agreement will be observed in this respect, viz., that, as a rule, the relative proportion of organic matter has increased. My own examinations show, what is not unnatural, that the variations during the same season may be considerable, and my personal observation does not extend back through a sufficient number of years to lead me to assert that the water of the lake is less desirable for general use, than it *has ever been before*. As far as my observation does extend, the water, as received in Boston during the years 1872 and 1873, has been more strongly colored, and otherwise less pure than in the two years preceding. The color and the increase in the amount of organic substances, seems to be due to the presence of a larger quantity of vegetable matter. To fix absolutely upon the exact causes to which this change is to be attributed, is not possible. That the introduction of Sudbury River has contributed somewhat largely, there is no doubt; during the year 1872, the amount of water taken from the river was estimated at 1,676 million gallons, or about 110 days' supply; during the year 1873 no water has been taken from the river.

Another cause which probably is to be taken into the account is, that the water finding its way to the lake from that portion of its water-shed occupied by the town of Natick is probably less pure than formerly; moreover, during the years 1871–72 the water was very low, at one time even below the bottom of the conduit, and was pumped from the lake; this drain upon the lake and its water-shed probably contributed its share to bring about the general result, and it is possible that the influence of Pegan Brook was

felt at the same time, not simply from its direct contributions, but from the drainage through the ground fouled by the material which is deposited from it. In this immediate connection it may be instructive to compare together the results obtained at various times from the examination of the water at the bar, which partly shuts off from the lake the waters of the meadow into which Pegan Brook empties. (Compare Nos. 43, 79, 96, 202 in Table V. or V *a*.) At the time the examination of No. 202 was made, the water in the lake was four feet below high-water mark, and, consequently, a considerable portion of the meadow was not covered with water. It is evident from the examination, that the influence of the material brought down by Pegan Brook was felt more at this time than previously, owing, no doubt, to the fact that the examination was made after a number of months of comparatively low water.

DATE.	OBSERVER.	PARTS PER 100,000.			GRAINS PER U.S. GALL.		
		Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.
July 1, 1834,	C. T. Jackson,	–	–	6.00	–	–	3.50
May –, 1837,	A. A. Hayes,	2.11	0.93	3.03	1.23	0.54	1.77
July 15, 1845,	B. Silliman, Jr.,	2.09	1.08	3.17	1.22	0.63	1.85[1]
Sept. 8, 1845,	"	3.78	1.99	5.77	2.21	1.16	3.37[2]
–, 1845,	"	4.54	2.38	6.92	2.65	1.39	4.04
–, 1848,	E. N. Horsford,	2.90	2.45	5.35	1.69	1.43	3.12
Dec. –, 1854,	C. T. Jackson,	2.59	1.84	4.43	1.52	1.07	2.59[3]
Feb. 1, 1855,	"	5.14	3.43	8.57	3.00	2.00	5.00[4]
	"	5.54	2.34	7.88	3.23	1.37	4.60[5]
	"	4.14	2.03	6.17	2.42	1.18	3.60[6]
Dec. –, 1870,	W. R. Nichols,	3.08	1.12	4.20	1.80	0.65	2.45
–, 1871,	S. Dana Hayes,	4.06	1.42	5.48	2.37	0.83	3.20
Oct. 1, 1872,	S. P. Sharples,	2.01	2.78	4.79	1.17	1.62	2.79
Dec. –, 1872,	W. R. Nichols,	3.00	2.30	5.30	1.75	1.34	3.09

[1] Near (proposed) aqueduct. [2] Upper division. [3] Boston. [4] Lower Pond.
[5] Middle Pond. [6] Upper Pond.

If, at the present time, the water of Cochituate Lake is well suited for all domestic uses, is there any well-grounded reason to fear for the future? Decidedly there is. The town of Natick, as stated in the last report of the Board, feels the

necessity of a water-supply. Whether this supply be taken from Charles River or from the lake, the *natural* outlet for any system of drains or sewers is to the lake. The introduction of water would, no doubt, soon and rapidly increase the proportion of filth brought down by Pegan Brook, and although the drainage of the more northern portion of the town would probably, for the present, be allowed to soak into the ground, and reach the lake only after an efficient purification, eventually, no doubt, it would find its way by actual drains. Moreover, at the present time, gas-works are being constructed in Natick, directly upon the brook, and the effect of these works will probably be to increase the amount of objectionable matter brought down into the settling-basins. How far this will affect the water of the lake remains to be seen. The discharge of gas-works into streams and ponds, in some instances, has been known to produce bad effects by killing the fish and by destroying the lower forms of animal life, which are important agents in preserving the purity of fresh water.

It is not necessary here to repeat what has already been said, as to the influence in general of sewage on the water of either streams or ponds into which it is allowed to flow; in the case of ponds or lakes, it is extremely important that no sewage-matter should be thrown into them. The changes to which such organic material is subject take place in the pond as in the river, and the destruction of the soluble organic matter is likely to be more complete if any does enter, especially if the water is drawn from the pond at a point distant from that at which it receives foul matters, so that, in a large pond, less immediate effect may be perceived than in the case of a river. The deposit of matter in suspension, which goes on continuously without the chance of removal by freshets, as in the case of rivers, is, however, preparing evil for the future. This deposit undergoes a slow process of decay, but increases continually, and is liable to be stirred up by heavy rains, especially after a dry time, when a portion of the deposit which forms at the point of discharge has been left uncovered by the water. The advantage of an intercepting lake, serving as a settling-basin, in the course of a polluted stream is great, and the water delivered from the

lake in such a case is superior to that received; the efficiency, however, of such an agent of purification can be but limited, and a portion of its efficiency consists, no doubt, in the fact that it collects water coming from springs and draining from the surrounding country, and thus dilutes the impure with a purer water.

It is from a very strong feeling of the danger of admitting sewage to any source of water-supply, that the hope is expressed that some measures will be devised for legally preventing such accessions. With the existing state of the law it seems impossible to obtain an injunction against such improper use of a water-course or of a pond, unless it can be shown, by actual proof, that the water is rendered unfit for use. It would thus be necessary quietly to observe the gradual deterioration of the water until actual sickness and death of water-takers made an injunction possible, and then the water would have been rendered almost hopelessly impure, and could hardly be brought back to its original state.

The proposed introduction of the water of Sudbury River into Lake Cochituate, or rather the introduction of the river-water in connection with that of the lake into Chestnut Hill Reservoir, furnishes another cause for anxiety. The river is not at present, to any considerable extent, the carrier of sewage. From the nature of the stream, it takes up, during the summer and fall, a large quantity of vegetable matters, which give to it a very decided color. Except in excessive amounts this vegetable matter is not reputed unhealthy, and experience has shown that water stored in reservoirs and exposed to light and air is freed, to some extent, from these matters. Although the presence of so large a quantity of vegetable matter renders it somewhat less desirable for general use, the water at the present time seems quite well suited, after storage, for domestic purposes. Its continued fitness, however, depends upon the care with which it is preserved from contamination. The difficulty of preserving any running stream free from contributions of sewage has already been alluded to; the Sudbury River is, however, rather favorably situated, and there is no immediate prospect that there will be a very large population along its valley. At Ashland, a few miles above Framingham, there are extensive but unfinished build-

ings, which were erected by the "Dwight Print Company" to be used as print-works. The buildings remain unfinished, and, as far as I can learn, there is no immediate prospect of their being put to the use for which they were designed, and if Sudbury River is to serve as a supply for the city of Boston, it is to be hoped they never will go into operation. The volume of water is not so large that the discharge from such an establishment could fail to have an unfavorable influence upon its quality, and the introduction of sewers and drains from the town of Ashland should also be prevented.

Another source of contamination to the waters of the Sudbury River will be that arising from the decomposition of the vegetable matter in the meadows overflowed in the formation of the proposed storage reservoirs (see Report of the Cochituate Water Board on an Additional Supply of Water, 1873, p. 34). The expense of removing the entire accumulation of vegetable matter, and of the peaty soil in which it grows, would be too large to make such a removal practicable, although it would be desirable. The decomposition of the vegetable matter will render the water disagreeable to the taste and unfit for many uses, but the effect, to judge from experience in other places, will be temporary.*

The growth of South Framingham and its approach to the shores of Farm Pond, through which the waters of Sudbury River have been diverted and which is connected with Cochituate Lake, afford further cause for anxiety. Little if any water has been drawn the present year from Farm Pond, but in view of its situation, and the possibility of its use, either permanently or occasionally, it should be jealously protected from any discharge of sewage-matter.

In connection with the examination into the character of the Boston water-supply, the following more complete analysis was made of Cochituate water in Boston, July 4, 1873 :

* Prof. Silliman cites a remarkable instance of this in the case of New Britain, Conn. See his Report on the Water-Supply from Upper Mystic Pond, Charlestown, 1862, p. 29.

	Parts per 100,000.	Grains per gallon.
Ammonia,	0.0033	0.0019
"Albuminoid ammonia,"	0.0120	0.0070
Inorganic,	2.84	1.66
Organic and volatile,	2.80	1.63
Total dissolved matters,	5.64	3.29
Chlorine,	0.34	0.20
Sulphuric acid (SO_3),	0.91	0.53
Silica,	0.28	0.16
Alumina, oxide of iron (with trace of phosphoric acid,)	0.85	0.50
Lime,	0.42	0.25
Magnesia,	0.06	0.03
Soda,	0.17	0.10
Potash,	0.25	0.15
Carbonic acid,	Undetermined.	–

Mystic Water.—The sources of supply, from which is derived the water of Mystic Lake, are very much inferior to those of Cochituate Lake. Before the use of the waters of the lake to supply the city of Charlestown its tributaries were already used as a receptacle for the foul refuse of various manufacturing establishments, and the amount of this material has increased up to the present time. An examination of several of the ponds and streams which contribute to the Mystic supply was made by the writer in 1870, and at that time it was not felt that anything in the condition of the water, as delivered at Charlestown, could be traced to these manufacturing establishments. It was, however, very strongly felt that this was a source of danger, and that except some remedy were found it would, in the course of time, bring about a very sensible deterioration of the waters of the lake.

The lake itself is less favorably situated than Cochituate; its main direct supply is afforded by the Abajonna River, which brings down refuse from a number of tanneries and other establishments. At Winchester, where it expands to a pond, it is joined by another stream, which serves as an outlet to the waters of Horn Pond. A map of this region was given in the report of the Board of Health presented in 1871. It will be seen that the distance from the head of the lake to

the town of Winchester is very short, and Winchester numbers already 2,645 inhabitants (census of 1870).

Although, from personal observation made since 1870, it seemed evident that the condition of things was no better than at that time, it was thought best to take several series of samples during the present year, and to submit them to chemical examination. With this view the examinations, the results of which are incorporated in Tables VI. and VI *a.*, were made in June, and it was our intention to investigate the matter further later in the season, but the prospect of a thorough investigation by the city of Boston delayed our action, and when a special commission was appointed by the city to take the whole subject into consideration, it was decided on our part to pursue it no further. I, therefore, early in November, communicated the results already obtained to the Secretary of the Board, with the hope that the influence of the discharge from the tanneries, glue-factories, etc., might be thoroughly investigated. Having had occasion during the past summer to pass many times along the Abajonna River, and to observe the water in the stream and in the pond at Winchester, I could not but be impressed with the danger of allowing so small a stream of water to be contaminated with the refuse from so many establishments. There seems to be but one way of efficiently protecting these streams from defilement, and it is by the construction of a sewer which shall collect this objectionable refuse-matter and convey it to a point below the dam on the Mystic River, or to some other point where it would contaminate no source of water-supply. I am unable to state the engineering difficulties of such a scheme, or the amount of water that would thus be lost to the lake. In the present condition of things I do not think any other plan would be found as efficient. It would very likely be possible, and perhaps in some cases advantageous to purify such refuse by the process of intermittent filtration through natural soil. This process was described in the last report of the Board of Health.

Attempts have been made to dispose of the liquid refuse from some of the tanneries by allowing the liquid to flow into pits and thence to soak slowly into the gravelly subsoil, the suspended matters which settle out being then removed

mechanically. This cannot be regarded in any sense as a satisfactory settlement of the question. As far as I am informed no attempts have been made involving *intermittent filtration;* that is, the alternate exposure of the soil to the air and to the matter filtered. This disposal of liquid refuse by the cesspool system is not new; attempts have often been made in the same direction before; the effect depends upon the locality chosen. No considerable purification of the liquid (except from suspended matters) is accomplished, and the liquid flows into the ground, to contaminate the stream if on the banks of a stream, to pollute the wells if there are such in the neighborhood; or if no present injury is brought about, the subsoil becomes saturated with the foul material, which may bring about evil results in the future. The purifying power of natural soil is not fully understood, but we know that any given soil possesses a certain limit of purifying power, and that if the soil be not intermittently exposed to the air that limit is soon passed. A considerable amount of a very foul liquid may be run on to even a rather smaller area without offence, and the drainage from this area may also be without offence, provided the flooding takes place intermittently, for as the liquid settles into the soil it drags air down after it. But when the liquid is allowed to stand upon the soil, and when, as it soaks gradually into the ground, fresh supplies of the liquid take its place, the ground soon becomes saturated, and the liquid, unpurified, or but slightly improved, mixes with the subsoil-water and carries the contamination to a long distance. Even where wells are sunk to a great distance (one was sunk at Bondy near Paris to a depth of seventy-four meters, or two hundred and forty-seven feet), the surrounding soil is not free from danger of pollution by the soaking of the foul liquid into the sides of the well.

The localities from which specimens have been taken are designated somewhat at length in the tables. The stream referred to by Nos. 24 and 25 is the one alluded to in the previous report. It takes the drainage from several tanneries in Woburn, and empties into the Horn Pond outlet, a short distance below the end of the pond. My note of the condition of this stream, June 16, 1873, was as follows:—

TABLE VI.—*Examination of Mystic Lake, etc.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Phosphoric acid.
					Inorganic.	Organic and Volatile.	Total.		
19[1]	1873—June 13, . . .	Bacon's Bridge, . . .	0.0133	0.0280	8.00	2.85	10.85	2.12	–
20[2]	13, . . .		0.0136	0.0251	9.00	2.50	11.50	2.00	–
21[3]	13, . . .		0.0135	0.0216	8.20	1.30	9.50	2.00	
22[4]	13, . . .		0.0133	0.0229	8.50	1.50	10.00	1.96	–
		Mean of 19, 20, 21, 21, . .	0.0134	0.0244	8.42	2.04	10.46	2.02	–
23[5]	16, . . .	Horn Pond outlet, . . .	0.0076	0.0181	4.90	1.50	6.40	1.24	–
24[6]	16, . . .	Tannery Stream, . . .	1.9120	0.1800	52.50	7.70	60.20	23.60	–
25[7]	16, . . .		1.7000	0.2000	55.70	5.00	60.70	24.80	0.5116
26[8]	16, . . .	Abajonna River, . . .	0.0266	0.0207	8.50	1.70	10.20	1.45	–
27[9]	16, . . .		0.0273	0.0241	8.30	1.50	9.80	1.60	–

[1] Taken at middle of right-hand span. 1 foot below surface.
[2] Taken at middle of right-hand span. $3\frac{1}{2}$ feet below surface.
[3] Taken at middle of right-hand span. 5 feet below surface.
[4] Taken at middle of left-hand span. $3\frac{1}{2}$ feet below surface.
[5] Taken 1 foot below surface. Stream about $2\frac{1}{2}$ feet deep.
[6] Taken at road-crossing.
[7] Taken near outlet.
[8] Taken above Moseley's Tannery.
[9] Taken below Moseley's Tannery. At northern culvert, under railroad.

TABLE VI *a.—Examination of Mystic Lake, etc.* [Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Phosphoric acid.
					Inorganic.	Organic and Volatile.	Total.		
19	1873—June 13, . . .	Bacon's Bridge, . . .	0.0078	0.0016	4.67	1.66	6.33	1.24	–
20	13, . . .		0.0079	0.0015	5.25	0.46	6.71	1.17	–
21	13, . . .		0.0079	0.0013	4.79	0.77	5.55	1.17	–
22	13, . . .		0.0078	0.0013	4.96	0.88	5.84	1.14	–
		Mean of 19, 20, 21, 22, . .	0.0079	0.0014	4.92	1.19	6.11	1.18	–
23	16, . . .	Horn Pond outlet, . . .	0.0044	0.0011	2.86	0.88	3.74	0.72	–
24	16, . . .	Tannery Stream, . . .	1.1150	0.1050	30.65	4.49	35.14	13.77	–
25	16, . . .		0.9920	0.1170	32.51	2.92	35.43	14.47	0.299
26	16, . . .	Abajonna River, . . .	0.0155	0.0120	4.96	0.99	5.95	0.85	–
27	16, . . .		0.0159	0.0140	4.84	0.88	5.72	0.93	–

"Tannery Stream crosses the road and runs through the fields into stream coming from Horn Pond. Very filthy and black. When filtered the color of the liquid still blackish. No. 24 taken at road-crossing. No. 25 taken in the fields just beyond the crossing of the branch railroad running to the ice-houses. Rocks and banks covered with a black, filthy scum. Odor bad. (Dead animal a little below the place added to the odor.) The amount of water flowing was not very great; it would perhaps be equivalent to a stream eighteen inches wide by one and one-half deep* flowing over a weir."

It is to be remarked in this connection, that even if there were no animal refuse thrown into the Mystic tributaries, the water would still be contaminated by a greater or less proportion of vegetable organic matter coming from the copious growth of aquatic plants, which in summer covers the bed of the Winchester Ponds and the banks of the Abajonna River.

The Merrimack River as a Source of Water-supply.

Of the cities on the Merrimack, Lowell is, at present, the only one which takes its water-supply from the river, although Lawrence will soon be supplied from that source; the works are now in process of erection. The character of the water has already been alluded to at some length. The suspended matter brought down by the river at certain seasons of the year renders it necessary that any scheme for using its water for domestic purposes should include some scheme for filtration. At Lowell it was at first proposed to accomplish the removal of the suspended matter, when found necessary, by means of filter-beds of sand,—a project which preliminary experiments showed to be feasible.† This plan was subsequently changed for one involving a filtering-gallery. This "filtering-gallery is situated about 1,500 feet above Pawtucket Bridge, in Dracut, on the northerly shore of the Merrimack River and parallel with it, about 100 feet from the water's edge. Its length is 1,300 feet, width eight feet and height

* This would amount to 0.24 cubic feet per second. The estimate, however, is but an approximation.

† See the Report of the Joint Special Committee on a Supply of Water for the City of Lowell, September, 1869.

(inside) eight feet. The top (inside) is level with the top of Pawtucket Dam. The side-walls have an average thickness of two and three-fourths feet and a height of five feet, and are constructed of heavy rubble-masonry, laid water-tight in hydraulic mortar. The walls support a semi-circular brick arch, one foot thick, made water-tight. Along the bottom stone braces, one foot square and eight feet long, are placed, ten feet from centre to centre between the walls, to keep them in position. The bottom is covered with coarse-screened gravel, one foot thick, to the level of the brace-stones. The depth of the excavation averaged about sixteen feet, which carried it down into the natural gravel-bed." *

At the lower extremity of the filtering-gallery is situated the inlet-chamber, from which starts the supply-conduit, and into which the water from the river may be admitted by a direct pipe. "The filtering-gallery was not intended to be used as the principal source of supply, but only during times of freshet, when the river contains a considerable amount of matter in suspension. When the water is clear, it is to be taken from the river through the inlet-pipe." From the inlet-chamber a *supply-conduit*, four feet three inches in diameter and 4,183 feet in length, conducts the water to the terminal-chamber, whence a 30-inch cast-iron pipe, 6,656 feet in length, extends to the engine-house. From the engine-house to the reservoir the distance is 2,666 feet, making the entire distance from the end of the filtering-gallery to the reservoir 13,505 feet.

Although the filtering-gallery was, according to the report quoted above, intended for use only when the river was rendered sufficiently turbid to be objectionable, up to the present time (December, 1873) no water has been taken directly from the river since the last week in July, when the engine was tested. As soon as the test was ended the river-gate was closed, and has remained closed ever since. The amount of water pumped during this time has been as follows† :—

* Third Annual Report of the Water Commissioners of the City of Lowell, January, 1873.

† For information on this and other points connected with the water-supply of Lowell I am indebted to Mr. George E. Evans, Chief Engineer of the Water Works.

August (from the 12th), . . .	11,906,518	gallons.
September, ...	22,111,990	"
October, ...	14,060,740	"
November, ...	9,932,230	"
December, ...	21,366,130	"

The theory on which this system of drawing a supply of water from the river is based is, that the water from the river which percolates the earthy or gravelly barrier between it and the gallery shall, deprived of its suspended matter, rise through the porous bottom of the gallery. "Bordering upon all rivers there are found, at intervals, narrow plains of gravel or sand, brought down and deposited there by the river under the varying positions of its channel-way. When these beds of gravel extend to a depth below the bottom of the neighboring stream, they will always be found saturated with water, mainly derived from that stream, and, however turbid the water of the river, this underground flow will always be found clear, provided that we tap it at a reasonable distance from the channel-way.* Several cities in Europe are supplied with water by covered galleries carried through these beds of gravel; and a few other cities besides Lowell, on this continent, are supplied, or to be supplied, in this way.

"In many cases these galleries are technically called filtering-galleries; but, in reality, they are mere receptacles and conduits for gathering water already filtered by a natural process. They serve nothing towards the filtration of the water, but only towards the collection of it and its transmission to the pumping-machines." (Kirkwood, Filtration of River Waters, p. 139.)

The filtering-gallery at Lowell is of this character, and although some of the water collected in it comes from the river directly, a large portion comes no doubt from the land side, and the underground water on its way to the river is thus intercepted. It was found that in the trial wells sunk before the construction of the filtering-gallery was determined upon, that the water stood somewhat higher in the well than in the

* Report on the Filtration of River Water for the Supply of Cities, as practised in Europe, made to the Board of Water Commissioners of the City of St. Louis, by James P. Kirkwood, Civil Engineer. New York, Van Nostrand, 1869, p. 17.

TABLE VII.—*Examination of Filtering Scheme at Lowell.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Sulphuric Acid (SO_3).	Silica (SiO_2).	Alumina and Oxide of Iron.	Lime.	Magnesia.
					Inorganic.	Organic and Volatile.	Total.						
101[1]	1873—Sept. 2,	Merrimack River, opposite inlet chamber,	0.0047	0.0153	1.76	2.32	4.08[2]	0.14	–	–	–	–	–
120[1]	10,		0.0047	0.0104	1.56	1.44	3.00	0.10	0.34	0.50	0.30[3]	0.55	trace.
121[4]	10,		0.0044	0.0100	1.80	1.84	3.64	0.12	–	–	–	–	–
207[5]	1874—Jan. 1,		0.0053	0.0100	2.48	2.00	4.48	0.20	–	–	–	–	–
102	1873—Sept. 2,	Inlet chamber,	0.0013	0.0027	4.84	1.80	6.64	0.24	–	0.40	0.20	0.86	trace.
119	10,		0.0013	0.0020	4.64	1.16	5.80	0.20	0.27	0.98	0.14	0.98	trace.
205	1874—Jan. 2,		0.0063	0.0037	5.20	1.20	6.40	0.26	–	–	–	–	–
103	1873—Sept. 2,	Engine-house,	0.0020	0.0057	5.64	1.44	7.08	0.38	–	–	–	–	–
74	July 10,	Water as delivered in Lowell,	0.0020	0.0067	5.24	1.48	6.72	0.30	–	–	–	–	–
206	1874—Jan. 2,		0.0037	0.0034	6.28	1.24	7.52	0.30	–	–	–	–	–

[1] Taken 100 feet from shore. 1½ feet below surface.
[2] The unfiltered water contained—inorganic, 2.00; organic, 2.40; total, 4.40.
[3] Trace of phosphoric acid.
[4] Taken 100 feet from shore. 6 feet below surface.
[5] Taken 100 feet from shore. 7 feet below surface.

TABLE VII *a.*—*Examination of Filtering Scheme at Lowell.* [Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Sulphuric Acid (SO_3).	Silica (SiO_2).	Alumina and Oxide of Iron.	Lime.	Magnesia.
					Inorganic.	Organic and Volatile.	Total.						
101[1]	1873—Sept. 2,	Merrimack River, opposite inlet-chamber,	0.0027	0.0089	1.03	1.35	2.38[2]	0.08	–	–	–	–	–
120[1]	10,		0.0027	0.0060	0.91	0.84	1.75	0.06	0.20	0.29	0.18[3]	0.32	trace.
121[4]	10,		0.0026	0.0058	1.05	1.07	2.12	0.07	–	–	–	–	–
207[5]	1874—Jan. 1,		0.0031	0.0058	1.45	1.17	2.62	0.12	–	–	–	–	–
102	1873—Sept. 2,	Inlet-chamber, . . .	0.0008	0.0016	2.82	1.05	3.87	0.14	–	0.23	0.12	0.50	trace.
119	10,		0.0008	0.0012	2.71	0.68	3.39	0.12	0.16	0.57	0.08	0.57	trace.
205	1874—Jan. 2,		0.0038	0.0022	3.04	0.70	3.74	0.15	–	–	–	–	–
103	1873—Sept. 2,	Engine-house, . . .	0.0012	0.0033	3.29	0.84	4.13	0.22	–	–	–	–	–
74	July 10,	Water as delivered in Lowell, ...	0.0012	0.0039	3.06	0.86	3.92	0.18	–	–	–	–	–
206	1874—Jan. 2,		0.0022	0.0020	3.67	0.72	4.39	0.18	–	–	–	–	–

[1] Taken 100 feet from shore. 1½ feet below surface.
[2] The unfiltered water contained—inorganic, 1.17; organic, 1.40; total, 2.57.
[3] Trace of phosphoric acid.
[4] Taken 100 feet from shore. 6 feet below surface.
[5] Taken 100 feet from shore. 7 feet below surface.

river, that its temperature was very uniform, being in summer very much colder than that of the river, and that it was also harder.*

Facts have been observed in connection with the filtering-gallery, also, which lead to similar conclusions, and which will be described in some detail. In the first place, the chemical examinations seem to show too great a difference between the character of the water in the gallery and that of the river-water to be accounted for by filtration through a hundred feet or less of gravel. A comparison between the water of the river and that of the gallery may be made by observing the results of the examinations recorded in Tables VII. and VII *a*. The samples numbered 205, 206, 207 were kindly procured for me by Mr. George E. Evans, Chief Engineer of the Water Works.

It will be observed that the total solid residue is larger and that the proportion of mineral matter is also larger within the gallery than in the river opposite to it. It will be observed also that the gallery-water contains a smaller proportion of nitrogenous organic matter as indicated by the "albuminoid ammonia." That the water, as delivered in Lowell, should differ somewhat from that in the gallery (compare Nos. 205 and 206) is not a matter of surprise, for the conduit which conveys the water from the gallery to the city is for a portion of the distance a tunnel cut through a hill of schist rock. The rock inside the hill has a tolerably well-marked dip of about 45° towards the north. The tunnel runs on the strike of the rock and consequently cuts the minimum number of lines of bedding; still some water does enter the tunnel along these lines, and also, though to a less extent, through the joints of the rock which have the same strike but have a dip which is at right angles to that of the beds.

Another point of observed difference between the river-water and the water of the gallery, is the relative proportion of the gases held in solution by the water. Thus, on September 10th, 1873, the water in the river opposite the gal-

* Mr. Kirkwood, in the report referred to above, speaks of the gallery-water at Lyons as containing a larger proportion of salts of lime than the river-water (see p. 137). It is a matter of regret that this standard report on the subject of filtration does not contain results of chemical examination.

lery, at a temperature of 20° C. (68° F.), to contain 1.84 cubic centimeters of oxygen to the liter *(0.43* of a cubic inch to the gallon) while that in the gallery, the temperature of which was 9.75° C. (50° F.), contained only 0.7 of a cubic centimeter *(0.16* of a cubic inch to the gallon*).

Determinations of the amount of oxygen in solution were also made in the laboratory, in the case of Nos. 205, 206, and 207, as follows :—

Number.	DATE.	LOCALITY.	Cubic Centimeters of Oxygen to the Liter.	Cubic Inches of Oxygen to the Gallon.
207	Jan. 1, 1874,	River, ...	7.90	1.82
205	2, 1874,	Inlet-chamber, ...	2.75	0.64
206	2, 1874,	Water as drawn in Lowell, .	7.45	1.72

The temperature of these samples *at the time of examination* was: No. 207, 8.5° C. (47.3° F.); No. 205, 7.25° C. (45° F.); No. 206, 6.75° C. (44° F.).

From these last determinations it would seem that, in the passage from the inlet-chamber to the reservoir, and during the exposure in the reservoir, the water takes up oxygen to

* Some of the same water was examined in the laboratory after being brought to Boston, and found to contain :—

	Cubic Centimeters per Liter.		Cubic Inches per Gallon.	
	River-water.	Gallery-water.	River-water.	Gallery-water.
Oxygen, . . .	1.904	1.015	0.440	0.234
Carbonic Acid, .	8.101	9.238	1.871	2.134
Nitrogen, . . .	7.339	7.424	1.695	1.715
Total, . .	17.344	17.677	4.006	4.083
Per cent. of oxygen in the mixed gases,	5.74	10.91	-	-

It is to be remarked that the amount of oxygen in the gallery-water was thus found to be greater than in the case of the determinations made on the spot, which is accounted for by the fact that a water so deficient in oxygen readily absorbs more of this gas when exposed even for a short time to the air.

about the same amount as exists in the river-water. It appears further, that during the winter the river-water itself contains much more oxygen than during the summer.

Another point of difference between the water of the river and that in the gallery is, that while the water in the river varies very much in temperature from winter to summer, the temperature of the water in the gallery is almost constant. No record has been kept of the temperature in the gallery itself, but observations have been regularly made in the well of the engine-house, which is essentially the same thing. During the month of September the highest temperature was 50° F., the lowest 49° F.; during the entire month of October, observations were made on thirteen different days showed identically the same temperature, namely, 50° F. Between September 6 and January 1, the highest recorded observation is 52° F., on November 8, and the lowest is 47° F., December 31, A. M. I have no corresponding record of the temperature of the river, nor is such necessary, as every one knows that river-water varies with the temperature of the surrounding air. The average temperature of the water in the reservoir has been :—

In August, ...	73.22° F.
September, ...	65.05° F.
October, ...	58.27° F.
November, ...	42.89° F.
December, ...	40.09° F.

It would seem difficult to account for this very great uniformity of the temperature of the water of the filtering-gallery on the supposition that the water is mainly derived from the river and simply filters through 100 feet or so of gravel.

It has been said that, in the trial well, the water in the gallery stood above the level of that in the river. I do not find this to be the case in the gallery. A record is kept of the height of water, not in the gallery itself, but in the well of the engine-house. Early in the day, before the pumping begins, this height may be taken as sensibly the same as that in the gallery.

It may be interesting to compare the height, at various dates, of the water in the gallery and in the river.

DATE.	Height Above or Below Top of Dam.		
	Of Water in River.	Of Water in Gallery.	Difference.
Sept. 2, ...	2ft. above.	0ft. 6 in. below.	2 ft. 6 in.
11, ...	1 11 in. "	1 7 "	3 6
Oct. 11, ...	3 0 "	0 2 "	3 8
22, ...	5 10 "	0 6 "	6 4
Dec. 3, ...	2 4 "	0 0 "	2 4
31, ...	2 3 "	0 0 "	2 3

The highest point at which the water has stood was on a level with the top of the dam; this point is recorded as having been reached only twice,—in both cases after an interval of nearly a week had elapsed since the pumps had been in operation. The highest point which the river reached during the interval over which comparative observations have extended (August 13 to January 1) was five feet ten inches; this was on October 22.

As far as the quality of the water goes, chemical examination points to no objection that can be urged against it; for although it is insufficiently aërated in the gallery, it seems, in the reservoir, to become as highly charged with atmospheric gases as the water of the river. The amount of organic matter is very small, the amount of mineral matter is not excessive, and it seems that, with the present demand upon it, the filtering-gallery furnishes water suitable in every way for domestic use.

Lawrence. At Lawrence the proposed water-works are now in process of construction, on a plan somewhat similar to that adopted in Lowell. In the experiments made to determine the best locality for a filtering-gallery, a well was sunk through sand, with some thin strata of clay, into a bed of coarse, clean gravel. The well was sunk to a depth of about eight feet below the river-surface, or five feet below the top of the Essex Company's dam. Two steam-pumps, whose united capacity exceeded 300 gallons per minute, working constantly night and

day, were just able to keep the surface of the water in the well about seven and one-fourth feet below that of the river. With such a draught upon the well, whose water-surface was about thirty-seven square feet, a large proportion of the incoming water must have been derived from the river; the water which came into the well was perfectly clear and transparent, and in taste and quality was all that could be desired.

"The whole river-bank being composed of sand and gravel, with very little material that would hinder the free passage of the water, the well was free to draw, not only from the river by direct filtration, but also from all the surrounding earth, which might be looked upon as an immense subterranean storage reservoir. That this was actually the case there are numerous indications. The amount of water delivered by the well gradually decreased as the pumping continued,—the rate of flow, after three weeks' pumping, not being one-half of that it was at first. The temperature of the water of the river at Lawrence was about 60 degrees, but the well-water was about 50 degrees, thus indicating that a large proportion of the water came from the earth, where the temperature remains quite constant through the various seasons, instead of from the river. The analyses of Dr. Hasenclever indicate the same thing in a different way,—samples of the water taken from the river showing 0.7 degrees of hardness, while those of the well showed 2.5 degrees." *

In the scheme for the city-supply it is proposed to draw directly from the river, except when the river is turbid.

In these schemes for filtration it is to be borne in mind that the filtering-galleries or basins are, in a measure, also shallow wells, and the subsoil, from which they derive in part their supply, must be carefully protected from impurities which would be brought from cesspools and vaults, and from drains.

It seems, as has already been said, that at the present time the water thus obtained is perfectly satisfactory in quality, and in reality superior to the river, not only on account of its quite uniform and low temperature, but also because of its containing a smaller amount of organic matter, and because the liability of contamination, if proper precautions be taken,

* See Report on Proposed Water-Works, Lawrence, City Document, 1872.

is probably less. As to the permanence of the supply there seems to be no cause for anxiety, although the amount of water which can be obtained is not unlimited. If the amount pumped from the gallery is so great as to cause a drain upon that portion of the supply which comes from the land side, it is probable that the water thus derived would be somewhat inferior, and that more than the ordinary proportion would be drawn from the river. In such case, in times when the river is very turbid, the water might fail to be filtered satisfactorily. It is not likely that any difficulty will arise from the silting up of the bed of the river, as it is sandy or gravelly in its character, and the freshets probably exercise enough of a scouring action to keep it clean.

Charles River as a Source of Water-supply.

For many years Charles River has been looked to by various municipalities as affording a possible supply of water for domestic use, and the controversy between those who favored Charles River and those who favored Long Pond (Cochituate) was, at the time of the proposed introduction of aqueduct-water into Boston, quite bitter, and gave rise to a host of pamphlets and newspaper articles. The introduction of water from this source into Dedham, West Roxbury, Brookline, Newton, Waltham, and Watertown has been proposed at various times since, but Waltham is at present the only town supplied.

The water of the river, as far as chemical examination can show (that is, in the upper part of its course), is at present quite well suited for domestic and manufacturing use, with the exception that, in some cases, the vegetable coloring-matter is objectionable,—interfering, for instance, with its use in connection with bleaching processes. Although, on account of the nature of the bed of the river and the soil through which it flows, the Charles is inferior to a river like the Merrimack, the great objection to be urged against its use as a source of supply is the danger to which it is liable of being made very soon the carrier of sewage from the growing towns upon its banks. The use of the water by the towns on the upper part of the stream, and the return of the water to the river as sewage, could not fail to have an unfavorable effect

upon its quality for use by the towns situated lower down on the stream, and such statements as the following, which appears in the Waltham Water Report (1872), are to be regarded as depreciating, although perhaps unintentionally, a matter which is really of great importance. "The question of sewage is not at present of immediate importance to us [inhabitants of Waltham] in its effect upon the quality of the water; undoubtedly, in time, as population increases upon its banks, some comprehensive system will have to be adopted; in a growing country like ours, we cannot provide for too great a distance in the future."

Waltham derives its water-supply in theory from Charles River, but the water is not taken from the river directly. Use, in this case, is made of what is called a filter-basin. This basin was constructed at the side of the stream, partly by making an excavation into the knoll, at the foot of which the basin is situated, and partly, on three sides in fact, by inclosing a portion of the river by a gravel embankment some thirty or forty feet wide. This embankment slopes outward on the river-side, but is walled perpendicularly on the side towards the basin. The idea at first was, that the river-water should *filter through* this gravel embankment, and the filtered-water should then be pumped into the reservoir and distributed for domestic use. Practically, it seems, however, that the basin draws the main part of its supply, not from the river, but from springs,—from the underground flow towards the river. Various circumstances point to this conclusion. In the first place it was noticed, before the construction of the basin, that in winter there was generally open water at this point in the river, or when ice did form in extreme cold weather, that it was thinner than on the river itself, indicating the entrance of warmer water from the land. Further, during the construction of the basin it was found that water came into it so rapidly from springs, that it was necessary to pump at the rate of 4,000 gallons per minute in order to remove the water that the work might go on; moreover, the water sometimes stands higher in the basin than in the river, and the temperature is quite uniformly 49° or 50° F. The pumps are now working from six to twelve hours per day, Sunday excepted. On Monday morning, when the weather is cold, the water—which

TABLE VIII.—*Examination of Filtering Scheme at Waltham.* [Results expressed in Parts per 100,000.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Sulphuric Acid (SO_3).	Silica (SiO_2).	Alumina and Oxide of Iron.	Lime.	Magnesia.
					Inorganic.	Organic and Volatile.	Total.						
197	1873—Dec. 16,	Charles River, at Waltham,	0.0060	0.0164	3.88	1.84	5.72	0.40	0.89	0.57	0.19	0.71	0.02
192	Nov. 18,	Filter-basin, . . .	0.0013	0.0033	5.20	1.20	6.40	0.44	1.50	0.75	0.28	1.59	trace.
194[1]	Dec. 16,	Filter-basin, . . .	0.0047	0.0056	5.60	0.92	6.52	0.38	0.84	1.03	0.03	1.63	0.17
195[1]	16,	Reservoir, . . .	0.0049	0.0049	5.52	0.88	6.40	0.36	[2]	[2]	[2]	[2]	[2]
193[1]	Nov. 17,	House of Dr. Warren, .	0.0060	0.0070	7.48	0.92	8.40	0.42	—	—	—	—	—
196	Dec. 16,	House of Dr. Warren, .	0.0020	0.0013	5.56	0.96	6.52	0.34	[2]	[2]	[2]	[2]	[2]

[1] These results were obtained from a mixture of equal parts of Nos. 193, 194, 195.

[2] See No. 194 above.

TABLE VIII *a.*—*Examination of Filtering Scheme at Waltham.* [Results expressed in Grains per U. S. Gallon.]

Number.	DATE.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	Solid Residue of Filtered Water.			Chlorine.	Sulphuric Acid (SO_3).	Silica (SiO_2).	Alumina and Oxide of Iron.	Lime.	Magnesia.
					Inorganic.	Organic and Volatile.	Total.						
197	1873—Dec. 16,	Charles River, at Waltham,	0.0035	0.0096	2.26	1.07	3.33	0.23	0.52	0.33	0.11	0.41	trace.
192	Nov. 18,	Filter-basin, . . .	0.0008	0.0019	3.04	0.70	3.74	0.26	0.88	0.44	0.16	0.93	trace.
194[1]	Dec. 16,	Filter-basin, . . .	0.0027	0.0033	3.27	0.54	3.81	0.22	0.49	0.61	trace.	0.95	0.10
195[1]	16,	Reservoir, . . .	0.0029	0.0029	3.23	0.51	3.74	0.21	[2]	[2]	[2]	[2]	[2]
193[1]	Nov. 17,	House of Dr. Warren, .	0.0035	0.0041	4.36	0.54	4.90	0.25	—	—	—	—	—
196	Dec. 16,	House of Dr. Warren, .	0.0012	0.0007	3.24	0.56	3.80	0.20	[2]	[2]	[2]	[2]	[2]

[1] These results were obtained from a mixture of equal parts of Nos. 193, 194, 195.

[2] See No. 194 above.

had then stood in the basin some thirty-six hours—is found to be skimmed over with ice, having acquired at the surface a low temperature; but, during the week, as the water is constantly renewed and constantly supplied, it is found that the temperature varies but slightly.

Chemical examination of water from the river and from the basin also leads to the same conclusion,—the water of the basin being harder, and containing less organic matter, as we should expect if the water indeed comes in considerable measure from the underground flow. The water for examination was obtained through the kindness of Dr. R. S. Warren, of Waltham, who attended personally to its collection, and the results of the chemical examination are incorporated in Tables VIII. and VIII *a*.

From the filter-basin the water is pumped through a cast-iron pipe, 2,950 feet long, into a reservoir situated at an elevation of some 130 feet above the main street; from this reservoir it is distributed through cement-lined pipes.

NOTE.

Since this Report was presented to the Board of Health, I have made a further comparison of the water in the filter-basin at Waltham, and that in the river, by determining the amount of oxygen held in solution in each case. The determinations were made on the morning of Saturday, February 7, 1874, on the spot. The temperature of the air at the outer portion of the filter-basin and on the river was —7° C. (19.4° F); at the inner portion of the filter-basin under the shelter of the engine-house the temperature was about —3° C. (26.6° F.), and while the river was completely frozen over the filter-basin was entirely free from ice.

The specimens examined were as follows:—

No. 213, from the river some ten feet from the embankment, taken six feet below the surface.

No. 214, from the river at the surface just under the ice.

No. 215, from that side of the filter-basin nearest the river, taken just below the surface.

No. 216, from that side of the filter-basin nearest the engine-house, taken from the bottom.

No. 217, from the faucet in the house of the engineer. This house is situated on the hill above the engine-house, and is supplied by a pipe from the force-main, not from the reservoir.

The results of the examination are as follows :—

Number.	LOCALITY.	Temperature in Centigrade degrees.	Oxygen in cubic centimeters per liter.	Temperature in Fahrenheit degrees.	Oxygen in cubic inches to the gallon.
213	River, 6 feet below surface, .	0.5°	13.07	32.9°	3.02
214	River, surface, . . .	0.°	13.20	32.°	3.05
215	Filter-basin, ...	6.5°	8.71	43.7°	2.01
216	"	7.°	8.71	44.6°	2.01
217	Dwelling-house, . . .	2.5°	10.02	36.5°	2.31

In connection with the facts already mentioned, these results would seem to confirm the idea that the water comes in considerable measure from springs. This *comparative deficiency* in oxygen cannot be offered as an objection to the use of the water for drinking, as the *absolute amount* is not small, and by exposure in the reservoir it, no doubt, absorbs oxygen; even just after it enters the force-main we see (No. 217) it is found already to contain rather more than in the basin. Moreover, a sample of water taken from the filter-basin in a (clean) wooden pail, the water being somewhat agitated by the operation, after being exposed to the air a short time, was found to contain 9.58 c.c. to the liter (*2.21* cubic inches to the gallon). That in respect to the dissolved oxygen there should not be as marked a difference as was observed at Lowell, is not strange, when we consider the large surface which the Waltham basin exposes to the air; it is possible, also, that determinations made later in the day—after the water which had remained in the basin for some time had been pumped out—would have shown a greater difference. It is proposed to make further examinations with reference to this matter.

APPENDIX.

[A.]

METHODS OF ANALYSIS.

Collection of Samples.—The water was collected in glass-stoppered bottles which have never been used except for this purpose. The water was taken, as a rule, at the depth of eighteen inches below the surface, and the bottles were thoroughly rinsed with the water to be collected before being finally filled.

Suspended Matters.—Various methods are in use for determining the amount of matter in suspension; none of them are perfectly free from objection. If there is considerable suspended matter it may be collected on a tared filter and weighed; this method is, however, quite inaccurate where small quantities are in question. The method of allowing the water to stand for some days or weeks and then collecting the sediment, is open to the very serious objection that even in the case of tolerably pure waters the chemical changes which immediately begin to take place alter very decidedly the amount and character of the suspended matters, an effect which is much more marked in the case of waters rendered impure by admixture with sewage or manufacturing refuse. The following method, as affording greater accuracy, has therefore been followed:—A portion of the water, well shaken up (100 or 250 c.c. according to its quality), is evaporated to dryness, and the weight of the residue determined; a quantity of the original water is then filtered through the best filter-paper, that which filters through at first being rejected, until the filter has been thoroughly washed with the water under examination. A portion of the water thus filtered is

evaporated to dryness, and the difference between the results obtained in the two cases may with sufficient accuracy be taken as the "suspended matter." In the foregoing tables the results of the analytical determinations are given just as obtained, and the suspended matter is not tabulated as such. When the amount of suspended matter was not large enough to estimate, the water was still passed through a filter in order that the results might be directly comparable with each other.

Solid Residue.—The amount of water taken for the determination of the solid residue was 100 c.c. or 250 c.c. according to the purity of the water. The evaporation of larger quantities tends to inaccuracy, as the operation is of necessity more prolonged, and in many cases the organic matter undergoes chemical change when subjected for a long time to the temperature of boiling-water. The residue was dried at 100° C. (212° F.) and weighed. It was then ignited at as low a temperature as possible, was treated with distilled water saturated with carbonic acid, and dried again at 100 degrees. The difference between the two weights appears in the tables as organic and volatile matter.

This determination of organic matter is sufficiently accurate for practical purposes, except when the water contains a considerable amount of nitrates and chlorides.

Chlorine.—The chlorine was determined volumetrically by means of a standard solution of nitrate of silver.

Ammonia and Albuminoid Ammonia.—The method of water analysis proposed by Messrs. Wancklyn, Chapman and Smith, of determining the amount of ammonia by distillation with carbonate of soda, and subsequently heating with a strongly alkaline solution of permanganate of potassium has been followed as affording the best and most available means at present at our command for obtaining indications of the amount of the nitrogenous organic matter in solution.

Oxygen.—The oxygen dissolved in the waters has been determined in several instances,—generally by the use of a titrated solution of hydrosulphite of sodium, as suggested by Schützenberger and Risler (see Bulletin de la Societé Chimique, XX. (1873), p. 145.) This method supplies a want long felt, of some ready and convenient means of

determining free oxygen, and the operation can be performed without difficulty in the open air, as for instance, in a row-boat or in other similar situations. For the determinations made during the summer, I am indebted to Mr. T. E. Pope. As, at that time, the complete details of Schützenberger's process, as finally adopted, had not been made public, we employed a method in some points modified from that originally suggested. To test the accuracy of the method employed, the following determinations were made, in which the results were compared with those obtained from the same water by the ordinary method of analyzing the gases dissolved by water (a Sprengel's mercury pump was used) :—

No. 105. Charles River water collected at Needham on September 5, was examined the same day, and found to contain—

	By gas analysis.	By titration.	
Nitrogen, ...	9.10	–	Cubic centimeters per liter.
Oxygen, ...	2.84	2.89	

No. 106. Charles River, Newton Upper Falls. The water was collected on September 5, and examined on the following day. The results were—

	By gas analysis.	By titration.	
Nitrogen, ...	8.08	–	Cubic centimeters per liter.
Oxygen, ...	2.95	3.00	

No. 107. Nearly same locality as No. 106.

	By gas analysis.	By titration.	
Nitrogen, ...	7.678	–	Cubic centimeters per liter.
Oxygen, ...	2.732	2.74	

No. 119. Inlet-chamber of filtering-gallery, Lowell, Mass. Collected September 10, examination made in the laboratory September 11.

	By gas analysis.	By titration.	
Nitrogen, ...	7.424	–	Cubic centimeters per liter.
Oxygen, ...	1.015	1.02	
Carbonic acid, ...	9.238	–	

No. 121. Merrimack River, Lowell, opposite inlet-cham-

ber of filtering-gallery. Collected September 10, examined September 11.

	By gas analysis.	By titration.	
Nitrogen,	7.339	–	Cubic centimeters per liter.
Oxygen,	1.904	1.85	
Carbonic acid,	8.101	–	

The determinations recorded in December, January and February were made by Miss E. H. Swallow according to Schützenberger's method, as finally adopted by him. The following determinations were made to test the accuracy of the process :—

No. 1. Cochituate water, as drawn in the laboratory of the Institute of Technology. The temperature of the water was 7° C. The results obtained were—

	By gas analysis.	By titration.	
Nitrogen,	16.69	–	Cubic centimeters per liter.
Oxygen,	8.13	8.16	
Carbonic acid,	1.47	–	
	26.29		

No. 2. Cochituate, drawn January 17. Temperature, 5° C. The results obtained were—

	By gas analysis.	By titration.	
Nitrogen,	16.498	–	Cubic centimeters per liter.
Oxygen,	7.674	7.82	
Carbonic acid,	1.704	–	
	25.966		

[B.]

Analysis of Charles River Water made by J. M. MERRICK. [See page 90.]

Number.	LOCALITY.	DATE.		Parts per 100,000.			Grains per U. S. Gallon.		
				Inorganic.	Organic.	Total.	Inorganic.	Organic.	Total.
2	Above Dedham,	May	13,	2.35	2.41	4.76	1.37	1.41	2.78
9	" "	June	9,	1.96	2.39	4.35	1.14	1.40	2.54
1	Cow Bay, side and centre,	May	13,	1.97	2.42	4.39	1.15	1.41	2.56
6	" centre,		26,	2.38	2.30	4.68	1.39	1.34	2.73
7	"	June	9,	2.84	2.30	5.14	1.66	1.34	3.00
12	"		23,	3.13	1.96	5.09	1.83	1.14	2.97
21	"	July	7,	3.19	2.45	5.64	1.86	1.43	3.29
25	" (after rain,)		21,	3.41	1.54	4.95	1.99	0.90	2.89
29	"	Aug.	11,	3.26	1.75	5.01	1.90	1.02	2.92
Y.	Needham Bridge,		14,	3.32	2.03	5.35	1.94	1.18	3.12
3	Waltham pump-basin,	May	22,	4.95	1.52	6.47	2.89	0.89	3.78
4	Waltham, River, side and centre,		22,	2.43	2.04	4.47	1.42	1.19	2.61

THE BRIGHTON ABATTOIR.

1. REPORT OF MR. MERIAM, PRESIDENT OF THE B. S. & M. ASSOCIATION.

2. DESCRIPTION OF THE ABATTOIR.

3. LETTER FROM MR. SCHULTZ DESCRIBING EUROPEAN ABATTOIRS IN 1873.

THE BRIGHTON ABATTOIR.

To the State Board of Health:

On the 17th of June last, after various delays consequent upon putting in complete running order the extensive apparatus and machinery of the abattoir, the work of slaughtering and preparing meat for market was commenced.

Since that time, up to January 1, 1874, 14,194 cattle, 2,700 calves and 150,000 sheep have been slaughtered. These numbers are estimated to constitute about one-third of the cattle and three-fourths of the sheep dressed for market in the vicinity of Boston.

The blood, bone and refuse, coming from the slaughtering of the number of animals above stated, have produced between five and six hundred tons of dry fertilizer.

When the buildings now being finished, and those contemplated shall have been completed, the Association will have accommodations for slaughtering 275 cattle per day, or two-thirds of the number required to supply the daily wants of our market. Another block of buildings for slaughtering cattle has been erected upon the foundation mentioned in my last report, and is nearly ready for occupancy. This block, with the stables attached, is convenient and commodious, and will increase the facilities of the Association one-half its present capacity. The foundation of another block has just been completed, and still another is in contemplation, as also a block, with a stable, for the preparation of tripe. All these will not be adequate to supply the demands of the business for buildings the coming year. Not less than one hundred thousand dollars ($100,000) should be expended in the erection of slaughter-houses alone, if the Association would receive all who will apply for accommodations on its grounds.

The magnitude of the work given this corporation to do far exceeds our expectations.

We have expended already, in lands, buildings and machinery, $492,000.

The rendering-house will need no outlay of importance for the present, having sufficient capacity and all needed machinery to treat the tallow, heads and feet, blood and offal which will be produced at the works for a long time to come.

The system adopted for the performance of this part of our work,—receiving all the products of slaughtering in sheet-iron wagons, and raising them on elevators to the openings in the tanks,—although not perfect, is certainly very satisfactory, and has met the approval of your Board; while the plan of elevating the slaughtering-rooms so that all the products of slaughtering, except meat, shall be dropped through openings into these wagons below, is found to work admirably, and makes the labor of keeping the slaughtering-rooms clean comparatively easy.

The suppression and consumption of the steam and gases from the rendering-tanks and driers have received very careful consideration. The steam and gases are managed in tight pipes, and directly after leaving the tanks are introduced into an apparatus where the gases are separated from the steam, the steam condensed and run into the sewer, and the gases drawn into a reservoir, from which they are driven, by means of a fan, to the fires, and consumed. This part of our work requires and receives the utmost care and unremitting vigilance during every hour of the twenty-four. Our task in this particular, however, is lessened somewhat from the fact that we treat all our material while it is fresh, never allowing any animal matter to remain on the premises uncared for. By means of our tight floors, ample sewerage, abundance of water and mechanical appliances, we are enabled to keep the premises clean and sweet. The problem, how to conduct the slaughtering of animals without giving offence, has been satisfactorily demonstrated at the abattoir during the few months that our works have been in operation.

Steam and water are important agents in our work. By the former we furnish to all the butchers warm water and warm rooms, raise up their cattle as required in dressing

them, keep all basements and offices comparatively warm, elevate all of our material to the required room for treatment, render our tallow and all offal, dry all the residuum and blood into animal dust, sift, grind and pack it into barrels. It also materially aids in the destruction of gases generated in rendering, and elevates our water to the tanks in the fifth story of the rendering-house. Thus elevated, the water becomes to us an indispensable agent. The tanks in which it is stored (of which there are two) are large, being thirty feet in diameter by eleven feet in height, made of boiler-iron, and hold 232 tons, or about 58,000 gallons each. Connected with these are distributing-pipes that conduct the water to every apartment and inclosure on the premises, except the first block of stables, which is furnished by means of pumps, one in each stable. Hose are kept in each room, and hydrants are placed at convenient points outside the buildings, so that all parts of the premises can be reached with water at a moment's notice. Water is furnished to all animals kept on the grounds, and is freely and constantly used in washing all the apartments. During the summer, our water-supply diminished to such an extent that it became necessary to provide other means to obtain the required quantity. After careful examination of the quality and quantity of the water to be procured, we constructed a well on the north-easterly side of the rendering-house, between it and the beef slaughter-house. This well is 20 feet deep and 18 feet in diameter and furnishes an ample supply of water for all uses.

We have also connected our pumps with Charles River by means of a six-inch pipe, thus providing a supply of water equal to any emergency.

The Butchers' Slaughtering and Melting Association is not simply a business corporation, and has no monopoly in the slaughtering business. Its conduct is under the supervision of your Board. It is subject to stringent regulations, instituted for the public health, comfort and convenience, and is therefore a public servant commissioned to furnish all needed facilities to those who apply for slaughtering on its premises, and further, to care for the refuse and offensive products so that there shall be no nuisance resulting from the business.

The Association has endeavored with its utmost ability and

with fidelity to fulfil its mission, although, as yet, it has not received aid in any form from the city or State, excepting only the privilege of doing the work. We are to look to the rendering department, to the product of our dried blood, bone and meat, the refuse of the business, for remuneration.

Fortunately our experience thus far warrants us in the belief that we shall be well paid, whenever we are able to accommodate those who desire to avail themselves of the advantages furnished at the abattoir. We confidently expect to more than double our present capacity this year.

Yours, most respectfully,

J. N. MERIAM, *President.*

BOSTON, December 31, 1873.

REGULATIONS

FOR THE CONDUCT OF THE BUSINESS OF THE BUTCHERS' SLAUGHTERING AND MELTING ASSOCIATION.

[Presented by the Association, and approved by the State Board of Health, at their meeting October 1st, 1873.]

I. There shall be a managing director appointed by the Board of Directors who shall have the general charge of the premises of the corporation, and of all work done on said premises, subject, however, to such rules and regulations as may from time to time be adopted by the corporation or imposed by the State Board of Health, conformably to the charter of the corporation.

II. Said managing director shall have the entire control over all assistants and employés of the corporation, and shall keep a constant supervision of the rendering-house and the basements of the slaughter-houses, and shall see that all rules and regulations of the corporation and of the State Board of Health are fully observed.

III. Every person occupying any slaughter-house, or killing or dressing any animal therein, shall, as soon as the animal is dressed, cause its offal, tallow, head and feet to be

dropped through the openings in the floor which shall be designated for the purpose. Whenever any animal is killed, the blood-hole in the floor shall be opened, so that all blood may run through the same. The hides and tripe of beef-cattle shall also be dropped immediately through the respective openings provided for the purpose. While the killing is in progress, the water-hole in the trough shall be kept closed. After the killing is over the blood-hole and all openings, except the water-hole, shall be closed. The water-hole shall be opened and the floor and walls of the slaughter-house shall be thoroughly washed down.

IV. The corporation shall provide in the basement a sufficient number of properly constructed wagons to receive the said offal, tallow, heads and feet, tripes, blood and hides.

The managing director shall cause one of said wagons to be kept constantly under each opening in the floor, while any killing is going on, and until the slaughter-house floor is cleared up after such killing.

V. All hides shall be removed under the direction of the managing-director to a part of the rendering-house to be called the "hide-room," where they shall be weighed and delivered to any person who shall have authority from the butcher to receive them for removal from the premises of the corporation; or, if the same are to be cured by the corporation, or on its premises, they shall be salted and taken care of under charge of the managing-director.

VI. All tallow shall in like manner be removed to the rendering-house and weighed and delivered to any person who shall have authority from the butcher to receive it for removal from the premises; or, if the same is to be rendered by the corporation, it shall be raised on the elevator to the rendering-room, and immediately rendered.

VII. All tripes shall be removed in like manner and delivered to the person authorized to receive them.

VIII. Any butcher who sells his hides or tallow for removal from the premises shall notify the managing-director of the name of the purchaser, and shall pay to the corporation his due proportion of the actual cost of the labor employed in removing said hides and tallow from the basement of the slaughter-house to the rendering-house, and of deliv-

ering the said hides and tallow to the said purchaser. He shall also take care that the purchaser of said hides and tallow shall come each day, at such time as shall be fixed by the managing-director, with suitable wagons to receive and remove from the premises all hides and tallow ready for removal, so that no tallow or hides shall remain on the premises of the corporation, except such as are to be manufactured by said corporation or on its premises.

IX. The corporation shall render all tallow that the persons hiring or occupying a slaughter-house on its premises shall request, and all that shall not be removed from the premises as provided in the preceding regulation—and shall sell or cause to be sold all tallow so rendered, shall keep proper books of account, showing the weights and amounts received from the sales of the tallow of each butcher—and shall receive for manufacturing and selling said tallow such percentage of the proceeds of such sales as may be fixed by the directors of the corporation from time to time. But this regulation shall not prevent the corporation from buying of any butcher his crude tallow at such price as may be agreed upon.

X. The corporation shall in like manner remove and render the heads and feet of all animals slaughtered on the premises and shall pay for each set of heads and feet such prices as the directors may fix from time to time, subject to the approval of the State Board of Health, unless the parties shall agree upon a price.

XI. All blood and offal shall be forthwith removed from the basement of the slaughter-house to the rendering-house, and raised on the elevator to the proper story for manufacturing it. Offal shall be rendered while fresh, and the scrap of all offal and all blood shall be immediately dried. All blood and offal shall be the property of the corporation, and the manufactured fertilizers shall be properly packed and stored for sale by the corporation.

XII. Pelts of sheep shall be dropped into the basement under the slaughter-house and removed every day.

XIII. All stables shall be kept clean and sweet. The corporation shall remove the manure from the stables and the yards as often as need be to keep the said stables and

yards inoffensive. The manure shall be the property of the corporation.

XIV. The corporation shall furnish the necessary power for hoisting, and the necessary hot and cold water for cleansing the meat and the slaughter-houses, and also water for the stables and stock-yards.

In the use of said machinery and water, the butcher shall exercise all reasonable care to avoid breaking the machinery and waste of water, or damage to the buildings.

XV. All leases shall be executed in the name of the corporation by the president, and shall require the lessees to conform to the regulations which may be made from time to time by the corporation and the State Board of Health.

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, BOSTON, October 1, 1873.

In accordance with instructions contained in chapter 365, section 4, General Statutes, 1870, the State Board of Health approve the foregoing regulations which have been presented by the Butchers' Slaughtering and Melting Association, and make the following additional

SANITARY REGULATIONS.

1. Only animals in health shall be slaughtered for food.

Dead or diseased animals, when received in ordinary consignments of live-stock to persons slaughtering on the premises, may be prepared for rendering in the basements, and thence immediately transferred to the rendering-house.

2. No parts of animals slaughtered elsewhere shall be brought to the premises of the Association, except by special permission of the State Board of Health issued in writing.

Permission to bring blood or offal (except fresh heads and feet) will not be given in any case.

3. All parts of animals slaughtered on the premises must be at once put in the places provided for their reception, and those which are to be rendered, dried or salted, must be so treated without delay.

4. Each slaughter-house and close-pen and the basements beneath the slaughter-houses must be thoroughly cleansed at the close of each day's work, and the cattle-pens and stables constantly kept in a clean and orderly condition.

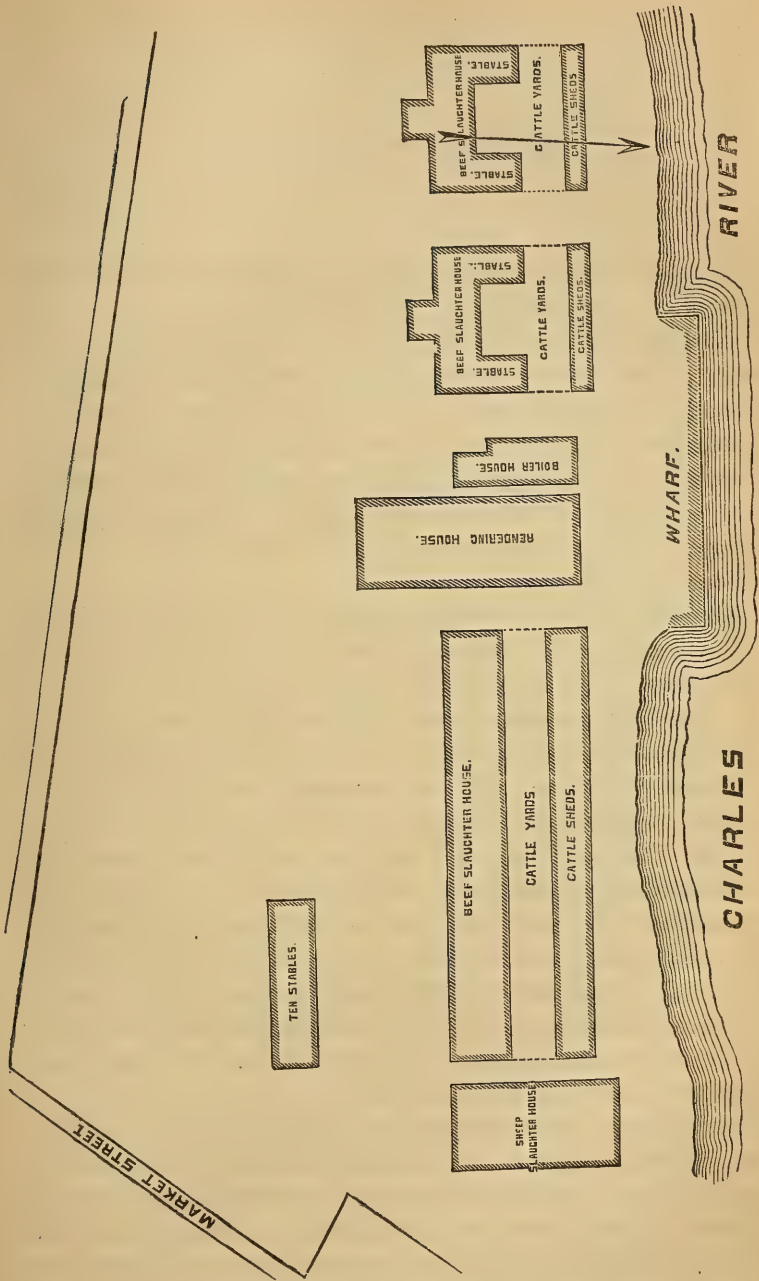
5. No injury or unnecessary pain shall be inflicted on any animal at the premises of the Association.

An ample supply of food and water must be served to animals at seasonable times.

6. Manure from the cattle-pens, close-pens and stables, and from the stomachs and intestines of animals slaughtered, must be removed from the premises as often as may be needed to insure cleanliness.

By order of the Board,

(Signed) GEORGE DERBY, M. D.,
Secretary of the State Board of Health.



PLAN OF BRIGHTON ABATTOIR.

DESCRIPTION OF THE ABATTOIR.

The following description of the Brighton abattoir is furnished by the architect, Mr. A. C. Martin :—

The abattoir now building at Brighton is well placed on the bank of the Charles River, in the most westerly suburb of Boston, and about four miles from the centre of the city. The grounds are about fifty acres in extent, bounded on the longest side by the river, and conveniently situated with reference to the Watertown and Brighton cattle-markets, the Boston & Albany Railroad and the Watertown branch of the Fitchburg Railroad.

Building operations were commenced, in the spring of 1872, by the butchers of Brighton under a charter granted by the legislature. The original plan contemplates a central building called the rendering-house, 200 feet by 80, and four stories high, around which are to be grouped ten or more blocks of slaughter-houses, with the necessary cattle-sheds, yards, stables, tripe-works, engine and boiler-house, etc. At the present time a block of ten beef slaughter-houses, and another block of five sheep slaughter-houses, with the requisite cattle-sheds, yards and stables, have been built and are now occupied. Several other beef slaughter-houses are in progress; one of these will be ready for use in a few weeks. The rendering-house, with the boiler and engine-house, has also been finished and the necessary machinery and steam apparatus put into the buildings.

Our abattoir differs from those in various countries of Europe in many respects. Foreign abattoirs have been built at public expense and are under the immediate charge of government officers; ours has been built by private enterprise and at private cost, its sanitary arrangements being controlled by the State Board of Health. In the foreign abattoirs the slaughter-houses are all built of masonry, and are one-story

high without basements. The slaughtering is done upon stone or asphalt pavement. No provision is made for cooling the meat before it is sent to market, and the blood and offal are carted away from the premises. At Brighton, the buildings are all of wood, and are planned with reference to the individual interests of the butchers and their special modes of doing business.

The offal and the blood coming from each day's work are rendered and dried on the premises during the same day, and while they are yet perfectly fresh and untainted.

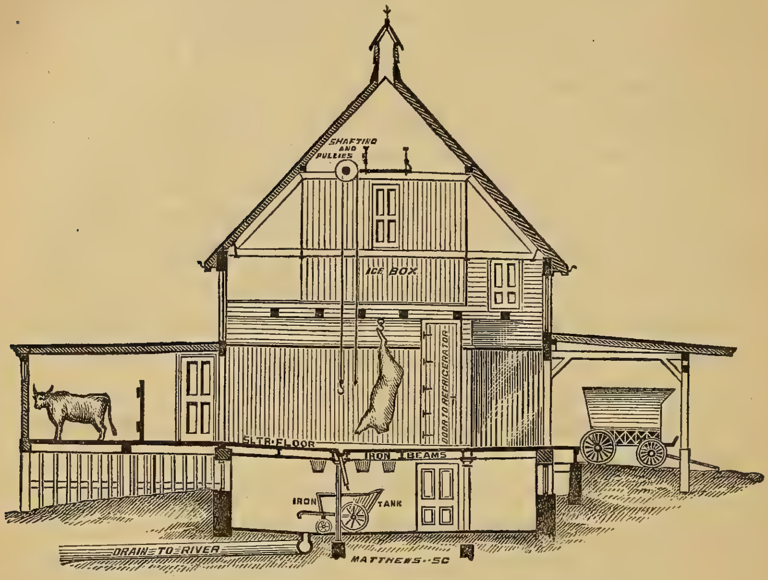
It has for a long time been the custom of the Brighton butchers to have, in connection with their slaughter-houses, a cooling-room, or refrigerator, in which the meat is kept at a temperature of 40° Fahr. for several days before sending it to market. These conditions required,—

First, That the slaughtering should be done upon a raised floor, over a basement-story, for convenience of handling the blood and offal.

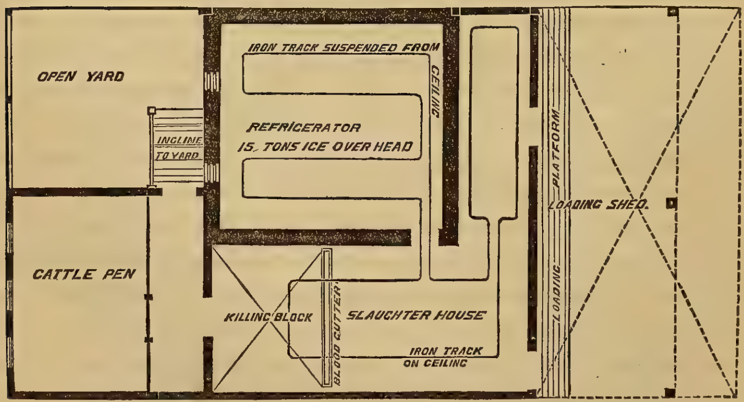
Second, That "cool-rooms" with ice-chambers over them should be provided for each slaughter-house.

By reference to the accompanying plan and section of one of the beef slaughter-houses, it will be seen that each covers a space 38 feet wide by 30 feet long, or 1,140 square feet. Out of this space a room twenty feet square is taken, with double walls (two feet thick) packed with fine shavings, for a "cool-room," in which the meat is hung for several days before being sent to market. The temperature is maintained in warm weather by the cold air from an ice-box of fifteen to twenty tons capacity built over the "cool-room" and connected with it. The circulation of air between the "cool-room" and the ice-box is regulated by means of valves in the air-ducts. The remaining space, fifteen feet wide, is used for slaughtering the cattle. The floor is of double plank, calked water-tight, like the deck of a ship, and laid upon iron beams with a slope to an iron gutter which catches the blood and conveys it below. There are several trap-doors in this floor, through which the hides, offal, etc., are dropped into separate iron tanks on wheels in the basement. The slaughtering-place opens to the rear upon the close-pen, the cattle-yards and sheds; and in front is the loading-shed, where the meat

is put into the wagons. The "cool-rooms" are twelve feet six inches high. The slaughtering-places have the whole height of the building up into the roof, and are lighted by

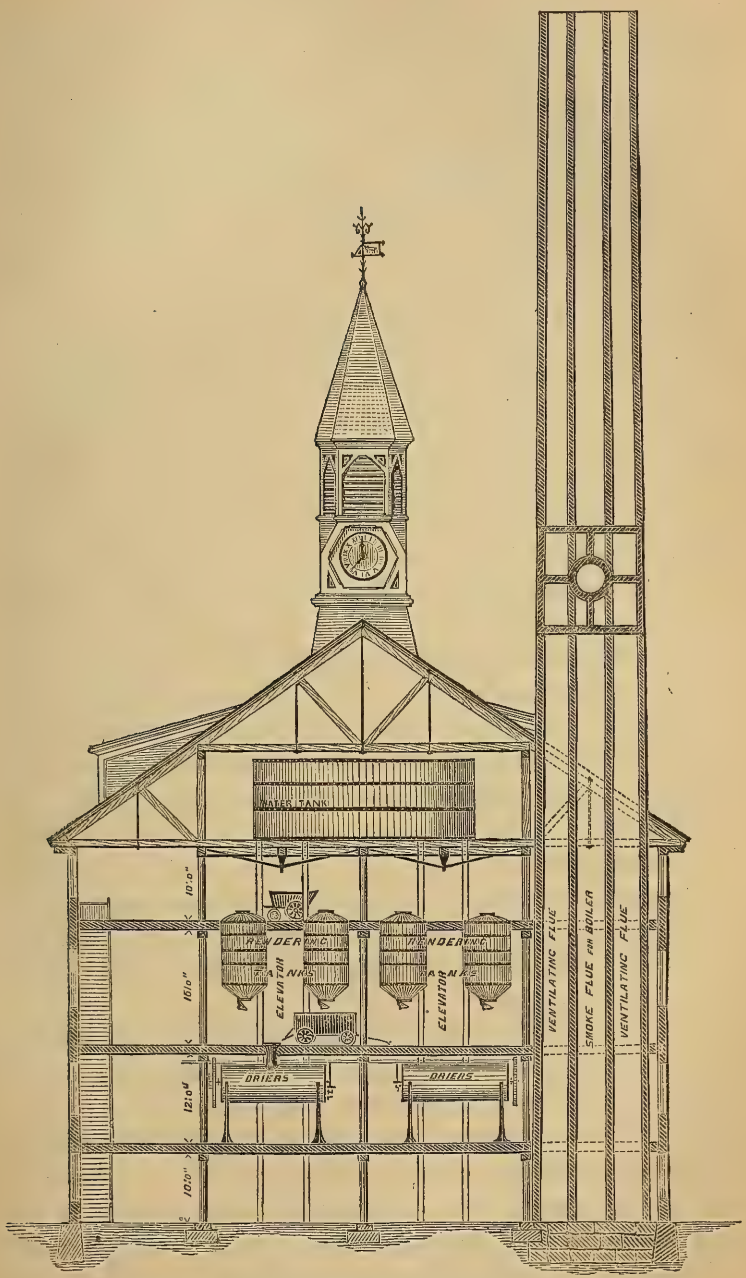


SECTION OF BEEF SLAUGHTER-HOUSE.



PLAN OF BEEF SLAUGHTER-HOUSE.

windows above the roofs of the sheds. By means of pulleys and shafting from the rendering-house, the cattle are hoisted for dressing, and the ice is lifted to the ice-chambers. Hot and cold water is supplied to each slaughter-house.



SECTION OF RENDERING-HOUSE.

The basement-story under the slaughter-houses is of brick walls, with a concrete floor, and has ample drainage. It extends without partition, 380 feet from one end of the block to the other. In this story, under the trap-doors, are the iron tanks (on wheels) to receive the hides, heads, feet, tallow, tripe, blood and offal. When filled, the tanks are wheeled into the rendering-house and their contents distributed,—the hides being left in the basement and the blood and offal taken to the rendering-tanks and driers by means of elevators.

The sheep slaughter-houses are similarly arranged, with "cool-room," slaughtering-place, etc., etc.

The rendering-house, which forms the centre of the whole group of the abattoir, is 200 feet by 80 feet, and four stories high, including a brick basement, which has a concrete floor like the basements of the slaughter-houses. The accompanying section-drawings show the rendering-tanks in the third story suspended from the fourth floor. These tanks open at the top, on the level of the floor of the fourth story, where the offal is emptied into them from the small "tanks on wheels" coming from the slaughter-houses.

After the rendering-tanks are filled, the openings are closed and the contents cooked by steam. After sufficient cooking, the contents are dropped out of the tanks by openings at the bottom of them in the third story. Here the fat is separated from the watery part and from the scrap or tankings, which latter portion is put into the driers. The blood from the slaughter-houses is also here put into the driers. The water is evaporated by steam-heat, and the residuum comes out as dry animal matter. This is passed through a mill and ground to powder. From the mill the powder drops into barrels, and is packed for market.

By an ingenious system of pipes, the steam and offensive gases from the rendering-tanks and "driers" are passed through a condensing apparatus, where the steam becomes water, and the remaining gases are then mixed with common air, and, by means of a blower, are forced down and under the fires of the steam-boilers. After being thus purified by fire, they are finally discharged through a chimney 160 feet high.

The rendering process thus conducted gives no odor. There

is nothing offensive about the fertilizer, and what slight odor it possesses is wholly imperceptible after it is packed.

The boiler and engine house, of brick, stand quite near the rendering-house, and around the central smoke-flue are constructed four large flues or shafts for ventilating the various rooms of the rendering-house. The boiler-house is planned for ten boilers; the engine-room for two fifty-horse-power engines. There is also a powerful steam-pump for throwing water.

The six months which have passed since the abattoir was opened have fully proved that it is possible to carry on a great slaughtering and rendering establishment, without its being offensive either to the workmen in it or to the community around it.

LETTER OF MR. SCHULTZ.

The following letter from Hon. Jackson S. Schultz, late U. S. Commissioner at the Vienna Exhibition, was sent to a member of the State Board of Health, in reply to one of general inquiry concerning European abattoirs.

LONDON, Sept. 14th, 1873.

DAVID L. WEBSTER, Esq.

MY DEAR SIR:—When I received your letter dated July 15th, making certain inquiries about the economies of slaughtering cattle and preparing the animal food for a city, I promised you in a hasty note in reply, that as I passed through the large cities of Europe, I would give some attention to this subject. This promise I have tried to keep; and shall now in a hasty and no doubt imperfect way give you the result of my observations and inquiries.

Already I have written two letters on this subject, which I suppose have been published in the "Shoe and Leather Chronicle," a trade paper published in New York.

In those letters I have rather considered the subject as affecting tanners—while you want to know more about the sanitary condition and effect of these abattoirs on the cities with which they are connected.

Although at Zurich (Switzerland) there is a very perfect abattoir, and also a very complete meat-market, yet the city is so small compared with Paris that doubters might say, indeed did say to us, in New York, "Oh, yes! in a small way cattle can be killed and their meat prepared without offence for consumption, but not in a wholesale way as at New York."

Remembering this statement, I determined to wait and inspect the abattoir system of Paris before coming to a conclusion. This I have now done, and I think it contains all the good qualities, all the excellencies of the Zurich system, and even some important improvements added.

The Paris system I regard as perfect for the country in which it is, and the circumstances surrounding. But all of the minute details of this system would be inappropriate for New York or Boston.

Let me give you one or two illustrations. The cattle in France and Switzerland are all "domestic animals" in the full sense of that word. They are brought up by hand, *i. e.*, handled every day, fed out of a tub, generally by children. The consequence is, that they are all gentle, and are easily led by a rope, or can be tied by the horns, where they will stand for days without worrying. They are led into a bath of clean water and washed as often as they shall soil their skins by lying down. [This is usually done when they first come into the yard, and it is found unnecessary to repeat it, for the perfectly paved ground on which they stand is washed daily.]

In this respect you will have to depart from their system, for I feel certain that the wild western steers that we handle in America cannot be thus tied and handled. But you can make some approach to cleanliness, which I am certain was not attempted by our old methods.

Then, too, the regulations are very arbitrary, and are enforced by military agents in Paris, and at Zurich by the police under military direction.

In America there must be a little "more play," or the "friction" would be too great.

For the reasons, then, that the rules and regulations would not be applicable, and for the further reason that the published regulations are obsolete (not at present enforced), I did not think it worth while to have them translated.

These domestic animals are brought from the country; when from a distance of more than ten or twenty miles, they are brought in railroad cars, and in both cases are driven immediately into the cattle-yards. (I should say that the railroad track communicates with the yard directly.)

This yard, I should judge, covers fully ten acres, and is paved in the most perfect manner with Belgian pavement (small square stones, such as are used in America). This pavement is placed on such graded surface as enables the water to wash down its surface frequently, and is kept perfectly clean.

The droppings of the animals are removed several times per day,—indeed several women are constantly employed at this work.

This yard is in part covered by iron sheds, with glass roofs and sides. These sheds are amply large to cover every animal. I should judge that two thousand head of cattle and twice this number of calves and sheep could very comfortably be cared for in these sheds, which are fully twenty feet high, and as light and airy as the uncovered portions. In addition to the large stone-bath for the cattle to wash in, there are fountains of water at various parts accessible at all times to the cattle to drink.

This bath is made of granite, and is about twenty by one hundred feet. It contains fresh flowing water, and this water (being the overflow from the fountains) in the centre or deepest part is about two feet deep, and runs off shallow to the ends and sides. Around the sides are granite steps on which the attendants walk as they lead the animals in and scrub or wash the legs and even the bodies of the animals.

In all of the great cattle-markets of Southern Europe, the cattle are not considered marketable until they are washed, and even their hair combed and brushed.

Much of this manipulation is impracticable with your wild western steers,—and even your sheep are wild in comparison with sheep that have always been attended by a shepherd and his dog, as is the universal practice here.

When the animals are sold, they are removed to the abattoir, which is but a short distance away from the cattle-market, and only those which are unsold remain. The care bestowed on these animals while in the yard both before and after sale is most tender. They are furnished with ample clean straw beds and are fed with the most tempting and nourishing food.

It appeared to me that instead of trying to see how little

could support life as with us, they tried to tempt their appetite and get them to eat as much as possible. The calves were fed with a *warm* meal mash, and when they refused to drink, the women in attendance forced it down their throats through the neck of a bottle-formed tin can.

I only mention these facts to show you that there is nothing that can contribute to the value and looks of the animal which is not resorted to. Connected with the abattoirs (I say abattoirs, rather than abattoir, for there are several buildings, and although all are included under one plan or system known as "The Abattoir," yet there really are many buildings and departments), are stables or stalls belonging to each slaughterer, and these stalls are kept in the same scrupulously clean condition as the yards before mentioned. I should judge that each slaughterer had stalls enough for about fifty head of cattle, and double that number could be accommodated by crowding. Here they are held and fed until wanted; sometimes they are held here for days and even weeks.

The slaughtering is actually done in an open yard, opposite to the place of storage. The carcass is drawn up from the open yard partly under the covered space, where the final dressing takes place.

There is nothing in this method of construction worthy of your imitation, for I am satisfied that, in our cold climate, so much exposure would not be borne by the men engaged; and, as there is no necessity for such construction, I assume that a fully covered building would be used,—as our "Butchers' Association" and other slaughterers have in the city of New York. The only peculiarity of their method of killing and dressing which attracted my attention was their method of "blowing up"—they call it "blowing off"—the hides or skins. This method you will find more fully set forth in my printed letters to the tanners. But the method has this additional interest to the health authorities. It is very questionable whether the insertion of air in the vessels of the meat does not induce decomposition; besides, if the air of the slaughter-house is impure, as possibly it may be, notwithstanding all the cleanliness observed, then why should such impurity be forced into the innermost recesses of the meat?

This practice of "blowing off or up" the carcass was in vogue in the city of New York twenty or thirty years ago, and was abandoned in obedience to an ordinance passed by the city authorities. I am satisfied that the real purpose of this "blowing up" is to make the meat look fuller, plumper and heavier than it would in its natural condition. The excuse given by the butcher is, that by this operation he can remove the skin with less risk of flesh-cuts.

This practice is followed in France, Germany, Switzerland, and Austria certainly, and perhaps other countries.

The practice bloats the carcass fully double its natural size, and it so remains until after it is cut up and prepared for market.

The blood is carefully saved from all the animals slaughtered. This blood has very considerable value, and is said to pay all the expenses of slaughtering; but I could not get this view confirmed by any responsible person. It is used by the dyers, and when prepared for their use it has an intrinsic value.

The butchers of Paris could not believe that butchers elsewhere could be so unmindful of their interest as to let this blood run away.

The meat from this abattoir is sold at public auction for the most part. I do not say, as has been said by others, that *it must be offered at auction*, but only that this is the usual course. I know that men can sell their own meat if they like without submitting it to auction.

What will interest you most is to know how they dispose of their tallow (rough fat).

All published accounts state that this fat is rendered *on the premises;* and so it was many years ago and during the first years of the experience of this institution, and for this purpose they built an extensive rendering-house, with a high stack, convenient to the main slaughtering-places, all within the inclosed grounds of the abattoir, and some of the rough fat is yet melted there; but the majority of the fat is taken away in sacks or bags. These are moved every day. I made some inquiry as to the cause of this change.

The reason assigned was this: "The Paris perfumers use a large amount in their works, and they can render it for them-

selves to much better advantage than can be done by the old method." In other words, the tallow from this abattoir goes into "the arts," rather than into the common uses to which tallow is usually put. The French make a great use of candles, and imitation sperm candles are made from tallow; and they affirm that they can render rough fat, when sweet, without any offensive odors escaping. It is certain that the candle-makers and perfumers do take most of the rough fat away in sacks, and that it is not tried out on the premises.

But at Zurich, each slaughterer has not only his own stables for his cattle, as at Paris, but also a small room adjoining his stall for the purpose of rendering his fat. This course is pursued also at Geneva, except that here the whole is done by one party for the joint benefit; *i. e.*, the rough fat is weighed and the product is divided.

I cannot, as I had hoped, report that these greases are tried out in these cities without giving off offensive gases. At all points, except Paris and Zurich, I found the practice subject of complaint. Indeed I found, to my surprise, that they had made no attempt to get rid of these offensive gases.

Trying out this rough fat while fresh and sweet, they claim is no more injurious to health, and should be no more offensive than the broiling of our beef-steaks for dinner.

I do not stop to discuss this question any more with you than I did with them. But this I say, *It is offensive;* and this offence induces the closing of our windows and doors,—thus shutting out the fresh, pure air of heaven, to which all are entitled. And it is the duty of boards of health to prevent the practice, *particularly as it is now demonstrated that the offensive gases from this boiling fat can be overcome, if not destroyed*, at very inconsiderable cost.

London, where I now am, is suffering immensely from these "butchers' nuisances." But by reason of certain legislative concessions, which do not expire until the year 1874, the board of health is comparatively powerless to suppress them. When a nuisance really exists, and it can be established under the common-law principle, then they may act.

You, in Boston, know as we did in New York how impossible it is to get a conviction under this law, or rather principle of law, and hence it is seldom or never attempted; but

here they are making arrangements to establish our abattoir system, to be put in operation in 1874, which will, as they claim, embrace all the improvements of the French and Swiss systems.

But I go back from my digression. The utilizing of animal substances is carried further in Paris than anywhere else.

There is no speck of the flesh of any animal that is not utilized. But particularly is this true of those meats that pass through this abattoir. The meats are graded, not only at the wholesale market, but in its progress to the consumer a constant separation of the qualities is being made until the dog and cat meat is reached; and, even after they are supplied, there is a residuum which goes to the growth of worms, which, in turn, feed the fish of the aquariums.

The markets of Paris are but a part of this whole system, and are owned by the government (I mean, of course, the public markets, not the several thousand small private markets held in stores and shops).

This whole system, cattle-yards, markets and abattoirs, belongs, with much other administration, to a department of the government which is presided over by a commission and a head commissioner. Hence you will see how difficult it is for me to answer many of those specific questions which I know would interest you, indeed which you so distinctly put to me. You want to know the *cost of rent* for the abattoir per head for cattle, swine, sheep, etc.,—market fees and rents, etc., etc. I do not say that these facts and figures could not be approximately got at by some one speaking the language, but with an interpreter I failed. The sale and utilization of vegetable substances are carried on with the same nicety as those of the animal.

In Paris, very little if any animal substance finds its way into the garbage-box; consequently only vegetable substances and street dirt have to be disposed of.

With a surrounding and outlying country for many miles occupied as market-gardens, you can well understand how glad these people are to get a fertilizer, and consequently all their trucks and wagons that go in during the early morning with vegetables, return with the sweepings of the markets (which amount to several hundred loads each day by actual

count), and in this way Paris gets rid of its street-sweepings and market-rubbish without cost to the city. The droppings of the horses in the streets during the day being carefully scraped up from hour to hour by private enterprize, very little is left to put into the carts.

But what surprised me more than any one thing was to find that the privies and water-closets of Paris do not connect with the sewers.

You have heard, as others have, of the grand and perfect sewerage system of Paris. I visited them, and found the water which was running quite free from impurities, and on further inquiry learned what my own common-sense might have suggested, viz. : that Paris would have *no right* to defile the river Seine, a stream that passes many other towns and cities on its way to the ocean. The method of removing and utilizing the night-soil at once engaged my attention.

They have large iron tanks placed on trucks or heavy wagons. These they drive into the court-yards (with which Paris abounds), and after running a suction-hose down into the sinks, by the action of a peculiarly constructed pump, which both "sucks" and "throws," they force the contents into the closely-inclosed iron tank. When the tank is filled and the brass cock turned, no more smell or odor escapes than from the most inoffensive substance, and the wagon is driven out of the city to a fertilizing manufactory. This substance is immediately transferred into barrels and shipped to a distance, and goes as ordinary cargo, without offence. The sanitary question has been raised this year, or rather renewed, and the health authorities are trying in some way to improve this method. Cholera, as you know, is supposed to be communicated by the excrement of the patient more than from any other cause. That is our theory in America, and it is now the theory here. But what say the sanitarians? Those of Paris, Vienna, Berlin and like inland cities say, What can we do about it? We have no river into which we can empty our sewers, as can the cities like New York, Boston, London, Liverpool, etc., and to alarm the people and tell them that they are living over and hourly inhaling into their system the virus of cholera, would only be to arouse them to their danger without the ability of removing the cause.

The sanitarians of Europe now concede that cholera does prevail in these inland cities more than in cities on the sea-shore, and particularly in those cities that have an efficient sewerage system (which many of the said cities on the banks of ample rivers, by the way, have not got).

Vienna is the most neglected and disgustingly filthy city of any city out of Italy, particularly in regard to the yards and privies; and cholera prevails there every summer, and must so continue until they change and improve their system of removing their night-soil.

I am not now giving you any theory of my own, but the result of the observations and experience of the best sanitarians in Europe.

The sewerage of a city has vastly more to do with its health than the slaughter-houses, and the sooner our boards of health come to this conclusion, the better it will be for all concerned.

There are many nuisances which affect the convenience and indirectly the health, and among these, slaughter-houses, fat-rendering, bone-boiling, etc., etc., are chief. But depend upon it, that a proper sewerage system is most important of all.

From the sewers there are communications with our dwellings, even with our sleeping-apartments, open passage-ways, from which and through which death may steal in and deposit its little germ. To properly trap these waste-pipes is of the highest consequence.

When I was in the board of health in New York, I had it in contemplation to call together the plumbers of that city and get one of the most intelligent of their number to lecture them on the importance of their trade in promoting the public health by doing good, honest work in their dwelling-house connections; and even now this should be done both in New York and Boston.

American cities are far ahead of the rest of the world in the plumber's art. But at best it is a new trade, only dating back to the time when water was first introduced into our cities, and there are many imperfect workmen even yet, as you well know. *The health department should absolutely control the sewerage and all sewerage connections.*

Remember, I am not drawing wisdom more from my own experience than the better judgment of learned sanitarians whom I have met on this side of the water. On this side of the Atlantic, these gentlemen go so far as to question the propriety of using gas in sick-chambers or sleeping-rooms, and hence we seldom find gas in any of the sleeping-rooms of either the public or private houses in Europe; and when gas is so introduced, the pipes are never run within the walls, but outside, so that if any leak should occur it may be discovered at once. This may be carrying the sanitary idea too far; but I mention it to show how vital pure air is, in their esteem, for the maintenance of perfect health.

From all I see over here, and contrast it with what we have at home, I am more and more satisfied that Boston, New York and Philadelphia may become the healthiest cities in the world, —*i. e.*, with the lowest death-rate. But there are so many improvements to effect,—improvements that will require legislation and restraint on the passions and prejudices of our people, —that I do not feel sanguine that in your day and mine all these reforms can be brought about.

An absolute government has many advantages over a republic in the establishment and enforcement of sanitary regulations. No doubt you have felt this in your efforts to benefit a people against their will. It is only by slow processes and even slower approaches that advance can be made in reform in this department.

I have read the first report of your "Butchers' Slaughtering and Melting Association," and I cannot conceive any plan better suited to accomplish the reform which your board seeks. If you can get all the butchers to join in this one enterprise, all the better, but if you shall be compelled to allow another, as we did in New York, that will not be objectionable.

Don't let any selfish capitalists come in and try to make money out of the job. Give the butchers a chance to take all the capital stock they want. Make your charges so reasonable that each butcher can see it to be his interest to join the new enterprise, for, depend upon it, when once they see the advantages to arise from association they will never give them up. I feel confident that our butchers would not go back to their old 317 slaughter-houses in the lower part of the city if

they could be assured of their rent free. Their saving in blood and offal at their new abattoirs more than pays their interest.

Our butchers are not as tidy and neat as the butchers here, nor are they as close and economical.

But time and competition will bring these new lessons, which all of us Americans will do well to learn. So do not let us expect too much of them at once.

New York has as good an abattoir system for America as Paris has for France. If we are to have a different or better plan we must grow into it. For that matter, we shall find the field of growth a large one, extending far beyond the slaughtering of cattle and the utilizing of animal substances.

I wish you to remember that my trip was undertaken in the interest of tanners, and most of my observations have been made in that direction, and only incidentally have I been called back to the subject of sanitary reform,—a subject which did certainly occupy my thoughts in New York for two years or more, and which even now I cannot quite dismiss from my mind.

Very sincerely and truly,

(Signed) JACKSON S. SCHULTZ.

THE HEALTH OF THE FARMERS OF MASSACHUSETTS.

By J. F. A. ADAMS, M. D., of Pittsfield.

WITH A LETTER ON

SOME FARM-HOUSES AND SOME MISTAKEN WAYS OF LIVING IN THEM.

By Mrs. T. F. PLUNKETT, of Pittsfield.

THE HEALTH OF THE FARMERS OF MASSACHUSETTS.

Every citizen of Massachusetts, with but few exceptions, is obliged to pursue some occupation for the support of himself and his family. The number of individuals, who, from inherited or acquired wealth, are independent of labor, is comparatively small; and consequently the great majority of our people are actively engaged in pursuits involving physical or mental toil, the interruption of which for any considerable period would involve privation. It is therefore extremely important that every person should be advised to what extent, if at all, his occupation is prejudicial to health, and have such a perfect understanding of its dangers and the means of escaping them, that he may not, through ignorance, find his pecuniary success early supplemented by his physical wreck.

It is proposed, in this paper, to consider a single occupation, that of the farmer, and to apply to it the same sort of investigation which has, in the previous reports of the State Board of Health, been applied to certain diseases and causes of disease. Thus we may hope to ascertain how far our agricultural class is exposed to the deleterious influences which prey upon the health of civilized man, and what special measures it is important that its members should take for improving their health and prolonging their lives.

The farmer is generally considered the healthiest of men: he breathes the pure air of heaven, untainted with city fumes; his labors develope his muscles and strengthen his digestion; he keeps early hours and is removed from the temptations of the town. To become a farmer in his declining years is the ambition of many a professional and business man, and he yearns for the life as bringing tranquil happiness

and renewed health. The young man who droops in the city is sent to the farm, and often returns, strong, vigorous and hard-handed. The poets of every age and language have extolled the farmer's life; and the great warriors and statesmen both of ancient and modern times have loved to turn, for strength and relaxation, to agricultural pursuits. It might, therefore, be supposed that an essay upon the health of farmers could have no other purpose than to describe them as affording the standard of health, and to hold them up to the admiration and envy of the rest of the world. Such is not, however, the object of the present paper, which is undertaken in the spirit of inquiry, to ascertain the actual sanitary condition of the farmers of this State, what dangers, if any, are incident to their calling, and, when necessary, to make suggestions tending to the elevation of the farmer still higher in the health-scale.

As this inquiry must, of necessity, be a practical one, it has been pursued by practical methods. Correspondence has been held with a number of physicians practising in agricultural districts in various parts of the State, asking the result of their observations and experience in reference to the health of our farmers and the causes by which it may be influenced. Outside of the medical profession, some valuable information has also been obtained, and the compiler wishes to express his grateful recognition of the prompt and satisfactory manner in which the desired assistance, from whatever source, has, when possible, been furnished. The country doctors, as a class, are men of whose thoughts and experience the world at large seldom gets the benefit, for their arduous duties deprive them of the leisure required for writing; but they are men, at least in our own State, of vigorous thought and close observation, their long drives afford ample opportunity for reflection, and their isolated situation makes them self-reliant and independent. A paper, therefore, based upon their combined experience cannot be otherwise than instructive.

After some preliminary observations upon the prosperity and social conditions of our farmers, their longevity, general health and the various influences to which they are subjected, will be taken up successively.

Social Condition and Prosperity.

The census of 1870 showed Massachusetts to contain 39,766 farmers, being one-eighth of all persons having occupations, and one-sixteenth of the whole population over the age of ten years. There were also 31,019 agricultural laborers, and 2,020 persons classed as gardeners, nurserymen, dairymen, overseers and stock-raisers. In 1860, there were 45,204 farmers and 17,430 farm-laborers, which shows an apparent decrease in the former, during the last decade, of 4,438; but, whether this is a real decrease, or only arises from a different mode of classification, is difficult to determine. That it is probably the latter, is shown by the fact that the aggregate of farmers and farm-laborers in 1870 was over 10,000 more than in 1860, the number of farm-laborers being nearly doubled. It is therefore likely that, in the last census, the definition of the latter class was extended to cover many, who, in the earlier census, were classed as farmers.

The *nativity* of the farmers in 1870 was as follows: 39,760, or 92.5 per cent. were born in the United States; 2,083 in Ireland, 213 in Germany, and 282 in England. Of farm-laborers, 23,974, or 77.28 per cent. were natives of the United States; 4,521 of Ireland; 164 of Germany, and 728 of England. It is interesting to draw a comparison with the nativity of persons engaged in the two other great branches of industry, thus:—

	Born in United States.
Farmers, ...	92.5 per cent.
Agricultural laborers, ...	77.2 " "
Persons engaged in trade and transportation,	82.6 " "
Persons engaged in manufactures and mining,	67.3 " "

Hence it appears that the farmers are the most strictly *American* class of all. Constituting, as they do, but one-eighth of the industrial population, their influence in the community is much less than in the great agricultural States of the West, where the proportion is much larger; for example, in Illinois the farmers make up a third of all persons having occupations, and with the farm-laborers, just a half.

It is not uncommon to hear persons familiar with the magnificent farming lands of the West express contempt for the

sterile soil of New England and commiseration for our farmers, who can barely, as they imagine, scrape from their stony hill-sides enough to keep soul and body together. And yet our farmers are comfortable and prosperous, despite our comparatively poor soil, our short summer and long winter, when animals must be housed and fed for half the year. We will even go so far as to assert that they are, on the whole, *more* prosperous than their brethren of the Middle and Western States, and, lest this statement be received with incredulity, will substantiate it by statistics.

The census reports give, for each State, the number of farms, acres of improved and unimproved land, cash value of farms, total value of productions for the year 1870, value of faiming implements and the amount expended for wages. From these data, it is quite easy to compute the average value of productions to each farm, the average value per acre of farming land, and the percentage of profit upon the invested capital. These results will be best shown by the accompanying table :—

	Production per farm.	Production per acre.	Value of land per acre.	Per cent. profit.
Massachusetts, ...	$1,214	$18.50	$42.64	25.3
New York, ...	1,172	16.20	57.48	18.7
Pennsylvania, ...	1,057	15.80	57.98	16.6
Ohio, ...	1,011	13.70	48.56	18.
Illinois, ...	1,030	16.20	35.56	21.5
Michigan, ...	824	15.90	39.74	19.4
Minnesota, ...	719	14.40	15.09	30.6

Here is revealed the somewhat surprising fact that the value of farm products is greater, both per farm and per acre, in Massachusetts than in any of the great fertile States enumerated; the value of land per acre is less than in New York, Pennsylvania and Ohio, but greater than in the others, and the percentage of profit is greater than in any other State except Minnesota, where the price of land is at a minimum. The percentage column in the table is, of course, too high for all the States, for it is computed without reference to the capital invested in buildings and stock, and the annual expenditures for fertilizers, seed, repairs and taxes. Still, it is ser-

viceable for comparison, for it is, in all cases, based upon similar data.

The fact that farming is more profitable in Massachusetts than in most of the Western States may be explained by our closer proximity to a market. A small and poor farm in our State will pay better than a large, fertile one at the West, because everything it produces is readily saleable, at a good price, and needs but little transportation, while many of our best staples are unmarketable at the West, and the Western farmer's splendid crop of wheat sells at a ruinously low rate, the railroad companies getting the lion's share of the profits.

Yet the Massachusetts farmers are not rich, as a class; and this is largely attributable to the fact that their wants are greater than those of their Western and Southern brethren. Living, as they do, in a wealthy and cultivated community, they must spend more money on their dwellings, dress and the education of their children, in order to keep up with their neighbors. But, notwithstanding this extra expense, the result of which is to increase their enjoyment of life by elevating them in the social and intellectual scale, they are generally not only above the reach of poverty, but able to accumulate.

This prosperity, however, is by no means uniform throughout the State, nor could it be expected in a State so unequally populated as ours, and so varied in soil and surface. Mr. Alexander Hyde asserts, in his recent work on agriculture, that the value of farming land, while it is rapidly increasing in the vicinity of the large manufacturing towns, is decreasing upon the hills, so that some farms can now be bought for less than the cost of the buildings upon them. There is an opportunity, therefore, for a great diversity of opinion in regard to the prosperity of our farmers. The Rev. W. H. H. Murray maintains that farming does not pay, and that this is the reason why young men are so unwilling to choose it as an occupation. A physician in the eastern part of the State writes that "a farmer in Massachusetts cannot make over two or three per cent. on his investment; hence, very few but stupid, lazy blockheads are found upon farms about here." We hope it is in but a small section where this is true. The reverse of the picture is drawn by the Hon. H. F. French, of Concord, in a recent letter. His description of the farmer's

condition in that classic town is so agreeable that we will quote it in full.

"The farmers in Concord,—where I live,—as a class, are in better condition, socially, intellectually and physically, than in most other towns, I suppose. This is a farming town, with no manufactures, and few of other callings, except a sprinkling of philosophers, lawyers and others who do business in Boston. I have attended a farmer's club of some forty members regularly for six years, and, as a supper closes each meeting, I know pretty well how they live. As a class, our farmers are intelligent enough to write essays worth publishing. They are out of debt, own good farms, and have all the comforts of life. Their daughters are well educated and teach most of our public schools, and many teach in Boston and elsewhere. There are about 186 persons in Concord, who own ten acres or more each. A number of these are not really farmers. We send to Boston annually, I estimate, enough *milk* to bring the farmers $140,000 cash, paid monthly. We send, it is said, more asparagus than any other town, and strawberries at the rate of one or two hundred bushels a day, in the best of the season, with a constant trade in market vegetables, in cranberries, grapes and other fruits in their season. Almost every farmer has, in addition to his market-wagons, a good carryall, and a large proportion, perhaps a majority, have pianos. We believe with our townsman, Emerson, that 'all true nobility rests upon the soil.' If the farmers in the rest of the Commonwealth are as well off as those in Concord, they had better be content."

Another phase of farming in this State is thus described by Dr. Haddock, of Beverly.

"We are not much of a farming community. Our farmers, for the most part, are men of good habits and steady ways,—men who have inherited their farms, which are mostly small, with but little land under cultivation, and raising mostly early vegetables and other light crops for the market. The real country farm is not known here. Many work in the shoe-shops and let 'the boys' carry on the farm, getting what they need off it, and selling what they do not want themselves. The boys leave as soon as they can, and so, between the two, the farm runs to waste. The girls can make as much in the

shop in a day as they can on the farm in a week or more, and have their evenings to themselves. A few, to be sure, pretend to be farmers, and do make some show of farming, but *money* is so much more readily obtained in other ways with us, that the farm answers more the purpose of a 'home' than a place of business. Our farmers are a shrewd, smart, healthy set of men, who can turn an honest penny at almost anything their hands find to do; and the children wander away and fall into other pursuits more congenial to their tastes and ideas of life, whether with better results remains to be seen."

In Berkshire County the farmers appear to thrive. Though the season is even shorter than in the rest of the State, they raise abundant crops of hay, corn, potatoes, and some tobacco. They send milk to New York, and have no difficulty in selling, at good prices, all the vegetables, butter, eggs and fowls that they can raise. With hard work and economy, they are as independent as any class of the community; but, if they grow *rich*, it is generally by some outside speculations, and not by farming.

The farmers of our State have generally what is known as a "common school education." While there are but very few who cannot read and write, the number who have a liberal education is extremely small. Indeed, excepting with the amateurs, education and agriculture seem to be almost incompatible in this State. The farmers' sons who are liberally educated invariably choose some other occupation in which there is less hard work and greater immediate profit, leaving the duller but industrious boys, who dislike books and love labor, to succeed to the management of the paternal acres. Of the graduates of the Agricultural College, even, but very few become farmers. The agricultural class, therefore, while furnishing the best of material to the professions and the various branches of manufacture and trade, does not itself make rapid progress in education and culture. Our farmers work more with their hands than their brains, and consequently have to work altogether too hard during the busy season. During the winter they read the newspapers, at least, and thus keep themselves posted upon general matters of interest. Hence, they are a sturdy, reliable class of men, of strong prejudices, slow to change their opinions, but possessed of shrewd common-sense,—a practical kind of wisdom which the highest

education frequently fails to confer. Their hard work and moderate means make them thrifty, sharp at a bargain, economical. Not infrequently, like other people, they run to the excess of economy, and fall into parsimony,—a vice, born of a virtue, which, like all vices, carries its punishment with it; and in no way is this more striking than in everything pertaining to health, for far too frequent are the cases where the health of the farmer and his family suffers seriously in consesequence of a mistaken or excessive economy.

But the great body of our farmers form the best of material for the dissemination of sanitary science, for their intelligence leads them to understand its principles and appreciate their value, while their practical ingenuity serves to apply them to the best advantage. We feel sure, therefore, that time and labor devoted to this subject cannot be wholly wasted, but is very likely to be productive of good.

Longevity.

The most reliable statistics upon the comparative longevity of farmers are contained in the Massachusetts Registration Reports. The tables are prepared by finding the average age at death of persons over twenty years of age, whose occupation is given. As the value of such tables chiefly depends upon the number of individuals included, the latest will be the best; and we therefore take from the report for 1871, in which are classified, by general occupation, all the deaths, over the age of twenty, occurring during a period of twenty-eight years and eight months, ending December 31, 1871.

	Number of Persons.	Average age at Death.
All classes and occupations,	122,536	50.94
I. Cultivators of the earth,	28,224	65.13
II. Active mechanics abroad,	9,029	52.62
III. Active mechanics in shops,	13,641	47.92
IV. Inactive mechanics in shops,	14,441	43.64
V. Laborers; no special trades,	23,544	47.24
VI. Factors laboring abroad,	6,044	35.42
VII. Employed on the ocean,	7,717	46.09
VIII. Merchants, financiers, agents, &c.,	13,013	49.22
IX. Professional men,	4,392	50.81
X. Females,	2,491	40.01

By this table it appears that 28,224 cultivators of the earth died at an average age of 65.13 years, being 14.19 years more than the average of all occupations, and 12.51 more than the next highest class, namely, active mechanics abroad. The figures, therefore, show the farmers to be, by far, the longest-lived class in the State.

But the value of this table is modified by the fact that occupations are very frequently changed; and, in its reference to farmers, that many persons first become farmers at middle age, purchasing their land with the money acquired in mechanical or mercantile pursuits. This would give them, in the table, an increased longevity, without indicating a corresponding life-prolonging tendency in their occupation. On the other hand, the table must give to some of the other classes too short a life-period, since, in the ceaseless struggle in this country for personal independence and higher social position, many laborers, artisans, and mechanics become, later in life, farmers, capitalists, or gentlemen of leisure.

In order to obtain further enlightenment upon this subject, the following question has been put to a number of physicians practising, more or less, in agricultural districts.

1st Question. "What rank do you assign to farmers, as regards longevity, in comparison with other classes of the community?"

Of forty-nine correspondents, eighteen say "first rank," one says "second," one says "third," six say "medium" or "average," and six make no answer. The remaining seventeen give answers, more or less general in character, which we cannot do better than quote in full.

Bonney.—After the so-called learned professions, I should say that it would equal that of any other class. Mere farm-laborers, I think, would not attain to so great an age as the farmers who own farms.

Burgess.—Should think they would be the longest-lived class, for these three reasons, viz.:—

1. They live out of doors.
2. They are too lazy to be hurt by overwork.
3. Too poor to be over-fed.

Clark.—When farmers are contented with their lot as farmers, I assign to them a long life and a happy life. Still, they may become broken down by

hard labor or killed by accident. But the average life of farmers is greater than any other class.

Crowell.—Not greater than that of persons in villages, engaged in mechanical pursuits, except operatives in mills. Less than that of professional men.

Goddard.—Much the larger share of old people here are farmers and their families, but I do not think their occupation has much to do with this. Think deaths yearly among farmers about the same as others, according to numbers.

Hawkes.—There are two classes of farmers,—the operative farmer or tiller of the soil, and the speculative or supervising farmer. The former, according to my observation, should fall low in the scale of longevity, while the latter would stand near its summit.

Hills.—Farmers live to as advanced age as any class of people in this vicinity.

Hosmer.—I cannot assign them the first, as the oldest people I have ever known have not been farmers.

Kimball.—I think, in this vicinity, the longevity of farmers exceeds that of almost any other class.

Lawrence.—Less, especially in the mountain towns, *e. g.* Florida and Savoy.

Morse.—I have no statistics at hand, but my impression is, that farmers, in this section, live as long as any other class of men, perhaps longer.

Paddock.—Compared with other classes of the community, it is my opinion that farmers are neither so short nor long lived as some. I should say their longevity was about medium.

Parks.—A front rank among the classes of laborers.

Stone.—Quite a high rank.

Webster.—Poorer than professional, but better than business men. About the same as mechanics.

Wilcox.—I should assign to farmers, from their necessarily active habits and out-door life, despite some unfavorable influences, a high position in the scale of longevity.

Winsor.—Above laborers, business men and "operatives"; below professional men.

From these replies, taken in connection with the registration tables, we cannot but form a favorable opinion of the longevity of farmers, and are probably correct in concluding that a farmer's chances of long life in this State are somewhat greater than those of any other class.

But it does not follow that the wives and children of farmers are longer-lived than the wives and children of men in other callings. In fact, there is much in the cares and duties

of a farmer's wife to break her down and shorten her life, while, of the children, some are injured by overwork at a too tender age, and the majority of the boys, after leaving school, engage in other pursuits, where they are subjected to new influences, of which an important one is the sudden and depressing change from an active, out-door life to a sedentary one. Our knowledge upon this point must therefore, of necessity, be vague and general; but, in order to obtain an expression of opinion from those most likely to know, the following question has been proposed to our medical correspondents.

2d Question. "What is the comparative longevity of farmers' *families?*"

To this question eleven correspondents make no reply, and the answers of the remaining thirty-eight are so general that any analysis of them is difficult to make. That they are shorter-lived than the farmers themselves is evidently the opinion of the majority. While but few put them in the first rank, sixteen place them high in the scale, and the remaining twenty-three assign them a medium or low position.

We will present, without attempting any grouping, such answers as possess any general interest.

Bonney.—Probably equal to that of any other class.

F. D. Brown.—The same rank (first) cannot be assigned to their families, from the fact that few of their sons or daughters remain at home or are employed in avocations connected with the farm, in this vicinity, at least.

W. S. Brown.—So far as I know, not greater than that of traders' or artisans' families.

Burgess.—Except that they are out of doors so much, they would be killed early by overwork and meagre diet.

Clark.—Children of farmers are robust and hearty, with good limbs and physical strength, better prepared to meet the rough usage of the world than children of sickly parents; therefore, longer-lived.

Cowdrey.—Farmers' wives too frequently die young. If they live beyond 40, their chance is good.

Dickson.—Males live to old age; females die much younger, averaging about 45 years.

Fisk.—Average. This is difficult to answer, as so many of farmers' children go into other spheres of life, from choice, marriage, &c.

Hartwell.—The families of those who have strictly followed agricultural pursuits are much more likely to reach or live to a ripe old age, than those of other callings.

Hawkes.—The above (see his answer to the previous question) would apply also to the families of the two classes. The former are drudges at home, while the latter are ladies of leisure, and would stand the same on the scale of longevity.

Hitchcock.—The number of farmers' families that continue farmers for several generations is very small in this vicinity. Children, in a larger majority of cases, are diverted into other pursuits; so that I can give no data or well-formed opinion.

Hosmer.—As compared with that of other classes in the community, it must hold some position intermediate between the two extremes.

Lawrence.—Longer than families of the town, except in the cold mountain towns, where many die of consumption.

Mercer.—Those of the family who remain at home and work on the farm, have a greater longevity than the other members of the same family who are engaged in the various other occupations of life.

Miller.—Average, except the females.

Morse.—This is a question difficult to answer. The daughters marry and leave; the sons grow up, and all but one leave for "distant fields and pastures new." I think the farmer's wife lives as long as the husband. The children of farmers generally inherit a vigorous constitution, and, under favorable circumstances, live long.

Paddock.—I think the longevity of farmers' families below the medium. The children, as a rule, are expected to work beyond their strength, the exposure they are subjected to sows the seed of future disease, and unfits them for the change of habits and of life generally, that many young people make when they leave the homestead for new work, as the majority of them are inclined to do, as soon as they are at liberty.

Phillips.—Where farmers' wives and daughters perform the laborious duties connected with a dairy, together with the care of a household, they wear out or break down sooner than the men.

Webster.—Less than that of classes that do less hard work. The women are apt to break down early.

Wilcox.—According to my observation farmers' families, as a class, are not so long-lived as farmers themselves. Farmers' wives, especially, are often brought under influences materially contributing to shorten life.

Winsor.—I have not a sufficiently extended observation to warrant my ex-

pressing an opinion; but I have an impression that the "families" are less *likely* to be long-lived, as being usually less vigorous than the fathers.

General Health.

To the general health of farmers, their longevity must be somewhat of an index; but to make our knowledge upon the subject more definite, professional opinions have been procured in the answers to the following question:—

3d Question. "How does the *general health* of farmers and their families compare with that of other persons?"

To this question, forty-four answers have been received. Of these, twenty-six say that it "compares favorably" or "is better," three that it "does not differ from other classes," eleven that it is "not as good," and four that the health of the men is better, and of the women not as good.

These four special answers are of a favorable character.

Bonney.—When not especially overworked, it will compare favorably with that of any other class of individuals.

Clark.—Better; frequently have I met with farmers who have informed me of the fact of never having taken a drop of any medicine whatever. It is not from this class that the physician realizes the most of his substance. We look to the mechanic more especially for our business.

Kimball.—Favorably; there is less sickness in farmers' families than among other classes, certainly less than among mill operatives.

Pickett.—The general health of farmers and their families, with good air and sunlight and a variety of employments, is better than others.

On the other hand, the following eight special answers are of a more or less unfavorable character.

Crowell.—The *relative* amount of sickness is quite as great as among our denser population.

Goddard.—They seem to have fewer days of sickness, but, when they are sick, not quite as likely to go through well.

Hawkes.—I consider that conditions in life have more to do with longevity than occupation. The general health depends on physical, mental and moral causes, whatever be the occupation. I think some of these causes are more prolific of disease in operative farmers' life than in other employments.

Hitchcock.—My belief is, that they suffer less from those diseases that are *climatic*, and perhaps less also from those that are hereditary; but I think in

this region (Worcester County), especially on the summit of our "water-sheds," and in the region of the sources of our streams and rivers, they get more typhoid fever and diseases of a malignant and typhoid type than do our mechanics and operatives in villages. This is an *impression*, having no statistics to guide me.

Paddock.—As a general rule, there is more sickness among farmers' families than among any other class of the community, excepting the poor Irish.

Scammell.—It is better than that of mechanics; not equal to that of professional men.

Webster.—Farmers enjoy good health, but grow old sooner. Ill-health prevails among the females of their families.

Wilcox.—A large class in Lee are operatives in the paper mills, among whom there is considerable sickness; next above this class I should place farmers' families, in the health scale. I have noticed more sickness among them than in the families of mechanics and merchants.

It is not surprising that a wide difference of opinion should exist upon this point, for a comparison of the general health of different classes, resting upon no definite data, can necessarily give none but approximative results. It is, however, the opinion of a large majority of our correspondents that farmers and their families enjoy better health than other people, while a respectable minority hold the reverse to be true. Further observation upon the subject will be most desirable.

Causes of Disease.

We have now reached the portion of our subject which possesses a decidedly practical value, viz.: a study into the influences which tend to impair the health and consequently shorten the lives of the agricultural class. As these causes come under the daily observation of every physician, and must necessarily receive from him much thought and study, an expression of professional opinions cannot be otherwise than extremely valuable. The question put to our correspondents is this:—

4th Question. "What *causes* tend to injure the health of farmers and their families?"

As information upon the causes of disease can never be too copious or minute, the answers will be presented in full.

L. S. Adams.—Exposure; too protracted hard work; excessive fatigue, especially in very hot weather.

Beane.—Overwork; want of recreation; neglect of bathing. My experience proves the sad neglect of this latter hygienic rule in New England.

Bonney.—Irregularity of work; exposure to wet and rough weather; want of care of the person; inattention to sanitary laws; indifferent food; want of recreation. That is, there is overwork at times, which seems to be a necessity, as in haying-time and harvesting, to secure the crops properly; and especially so with those who raise tobacco, in planting-time, when the setting is done by preference in the rain; also the hurry of gathering to escape frost.

F. D. Brown.—Their habits of life.

W. S. Brown.—Deficient ventilation; salt meat, imperfectly cooked; and great exposure to cold and wet weather.

Burgess.—Of farmers, exposure in rough weather, and liquor; of their families, overwork and poor fare.

Clark.—Overwork; overtaxing the strength; weakening the powers of endurance by too much crowded upon them. They do not understand enough of physiology and hygiene for their own good.

Collins.—Too much work, and exposure in bad weather.

Cowdrey.—Hard work during the process of digestion.

Crowell.—Insufficient and badly cooked food; damp cellars; small bedrooms opening from the kitchen; improper drainage; proximity to pigstys and barn-yards; want of vaults to privies, &c.

Davis.—Insufficient sleep; want of variety in food; sometimes malarial influences.

Dickson.—Excessive labor; improperly cooked food; imperfect ventilation.

Eastman.—A general carelessness as regards sanitary precautions in and about their dwellings.

Eddy.—Proximity of nuisances, viz.: privies, pigpens, sink deposits, &c., and imperfect drainage.

Fisk.—Nothing more than hard work, that I know of.

Goddard.—Defective drainage; larger amount of decaying vegetation about them, and too much salt meat in their living; also poor drinking-water.

Haddock.—Perhaps overwork and want of sufficient recreation of the proper kind.

Hartwell.—Improper food, and a good degree of unnecessary exposure; also a want of proper apportionment of labor, so as to prevent, at times, overwork.

Haskell.—Overwork and exposure.

Hawkes.—Active farmers are constantly and necessarily exposed to the sudden changes incident to our climate, at all seasons of the year, which are prolific sources of functional derangement. That class of farmers, too, are more subject to accidents, which often, primarily or secondarily, affect the general health of the whole subsequent life.

Hills.—Exposure to cold and wet, and overwork at some seasons of the year, in the case of the men. Overwork, anxiety, being over hot stoves, and, many times, needless exposure, among women. And among all (men, women and children, but especially children), there is more or less suffering from improper diet.

Hitchcock.—Farmers, like other people, sometimes overwork and commit errors in diet; and, in this vicinity, I think, "worry" a good deal in their hopes and fears about crops and their unequal competition with the great farmers of the West.

Hosmer.—Monotonous hard work; insufficient variety in the kind of food; unwholesome articles of food, of poor quality; inferior cooking; too little attention to the ventilation of sleeping-apartments.

Jones.—Their long and arduous day's work, and the regimen.

Kimball.—I know of none, unless overwork on the part of females.

Kittredge.—Overexertion in hot weather; also exposure in going to and from market.

Lawrence.—Lack of ventilation; low, close rooms; damp cellars, filled with decayed vegetables and other filth; privies without vaults; and a general lack of cleanliness about the house and yards.

Martin.—Want of cleanliness about cellars, and defective drainage.

Mercer.—Late and early hours at work, and underfeeding.

Miller.—Number of hours of labor; exposure to extremes of heat and cold; restricted diet; want of recreation and of the *unbending* of mind and muscle which prevents "all work" from making "Jack a dull boy."

Morse.—Improper food; badly cooked food; too long hours of labor; exposure to wet and cold; and the excessive heat at haying and harvesting.

Paddock.—Irregular hard work, and exposure to the changes of the weather, when fatigued and perspiring; many of them are rendered unable to resist the ordinary diseases by the abundent use of improperly prepared food. Then, as a rule, the drainage about farmer's dwellings is deficient, and ven-

tilation is almost wholly neglected. More than any other class, they are devoted to the use of quack remedies.

Paine.—Exposure, hard work, and a diet not sufficiently varied.

Phillips.—Excessive labor, in connection with depressing mental anxiety for the welfare of their crops, at certain seasons.

Pickett.—The location of barn-yards, hogpens and privies too near the dwellings.

Reynolds.—Overwork; working too many days in the year; not taking enough recreation; one continual drudge from morning to night; always in a hurry; no time to think of anything but work! work! This is enough to kill even a farmer, who should, by constantly inhaling pure air during his out-door work, be the most healthy of men.

Scammell.—Overwork and overeating.

Seymour.—None, as a general rule.

Smith.—Among men, overwork. Among women with dairies, work requiring too hard lifting. With children, too much and hard work, while the physical power is immature.

S. E. Stone.—Overwork and exposure.

Taylor.—Overwork and "common diet."

Vermilye.—Overwork, poor food and general ignorance of, or inattention to, the laws of health.

Webster.—Hard work, but more especially the monotony of their work; inattention to hygiene. Farmers' wives are more confined indoors than those of any other class. Exposure to cold and wet.

Wheeler.—I do not know of any, unless it may be from taking cold, after profuse perspiration, bringing on fever or rheumatism. This refers to farmers more particularly than to their families.

Wilcox.—Improper food, and food improperly cooked. Injudicious location of dwellings, and ignorance and neglect of sanitary laws in their surroundings. The wife of the farmer, too, is often obliged to work too many hours, and harassed with almost constant care, which necessarily affects her health and that of her progeny.

Winsor.—Unwholesome and ill-cooked food. Lack of ventilation (stoves and closed chimneys play a large part in this). Excessive tea-drinking (mainly by the women, but sometimes by the men). On the part of the women, too close confinement to the house, and overwork there.

To summarize this correspondence, we find that, of the 46 answers,—

Overwork is mentioned in	26
Exposure, ...	18
Improper diet, ...	22
Sanitary defects, pertaining to barn-yards, hogpens, privies, drains or filthy cellars, ...	10
Want of ventilation, ...	7
Overwork among women, ...	6
Irregularity of work, ...	3
Ignorance of hygienic laws, ...	3
Anxiety, ...	3
Indoor life of women, ...	3
Want of recreation, ...	5
Neglect of bathing, ...	2
Damp cellars, ...	2

While *their habits of life*, *intemperance*, *insufficient sleep*, *malaria*, *impure water*, *accident*, *excessive tea-drinking* and *quack medicines* are each mentioned once, and one correspondent says, "None, as a general rule."

Farther on, the most common of these causes will be separately considered.

Prevailing Diseases.

To obtain information under this head, the following question was asked :—

5th Question. "What diseases are most prevalent among the agricultural class?"

In reply, each of our correspondents has mentioned several diseases which, in his region, appeared to be most frequent. By arranging these in a table, we shall be best able to form an estimate of the general opinion.

Of forty-nine correspondents,—

Rheumatism is mentioned by	28
Pneumonia, ...	12
Pulmonary affections, ...	10
Phthisis, ...	9
Pleurisy, ...	4
Bronchitis, ...	4
Catarrhal affections	4
Typhoid fever, ...	12

Fevers, ...	11
Diarrhœa, ...	4
Dysentery, ...	6
Dyspepsia, ...	10
Congestion, nervous diseases, neuralgia, each, . .	2
Quinsy, asthma, zymotic diseases, scarlet fever, erysipelas, contagious diseases, cerebro-spinal meningitis, gastritis, "of circulatory system," heart-disease, uterine disease, cancer, insanity, headache, hernia, varicose veins, each, ...	1

To a certain extent, this table may be taken as an index of the comparative frequency of diseases among farmers; yet, being based upon no statistics, but only upon a random expression of opinion, it cannot but be unsatisfactory. Rheumatism, it is seen, occupies the first place, being mentioned by twenty-seven out of forty-nine; and it is probably true that, in its acute and chronic forms, no disease is more prevalent than this. The replies to the 4th question bear out this conclusion, since *overwork* and *exposure*, the common causes of rheumatism are mentioned as the chief disease-producing agencies. Typhoid fever is mentioned by twelve, and *fevers* by eleven. As both terms are not used by any one correspondent, we may, for practical purposes, add them together, when we find that fever (probably, in all cases, typhoid) is mentioned by twenty-three, or nearly half of the correspondents. Next come the lung affections, pneumonia being mentioned by twelve, consumption by nine, "pulmonary affections" by ten, and pleurisy, bronchitis and catarrhal affections each by four. Dyspepsia is mentioned by ten, and diarrhœa and dysentery by four and six, respectively. An evident fault in this order lies in the position held by dyspepsia,—a disease second to none in its prevalence among the wives and daughters of farmers, and also common enough with the farmers themselves. This fact is foreshadowed in the answers to the 4th question, wherein "improper diet" is mentioned by twenty-two as one of the chief causes of disease. It is not at all unlikely that dyspepsia would have been mentioned by nearly all of our correspondents, were it not so much a matter of course in farmers' families that it grows to be regarded rather as a

normal condition than a disease. Probably a more correct order of prevalent diseases is this:—1st, rheumatism; 2d, dyspepsia; 3d, fever; 4th, acute lung affections; 5th, consumption.

There is no available means of verifying these conclusions by statistics; for, outside of hospitals, no official record of diseases is kept. No information can be obtained from tables of mortality, for the comparative fatality of these diseases is no guide whatever to their comparative frequency. A most valuable investigation would be to tabulate by occupations the deaths from the most common diseases, in order to compare the farmers with other classes; and, although this would not necessarily be a sure indication of the comparative *prevalence* of those diseases, it is to be regretted that we have not at hand the means for preparing such a table.

The chief influences to which farmers are subjected will now be considered individually, in order to determine, as far as possible, the agency of each in modifying the health of the farming community. They will be taken up in the following order:—

1. The farmer's work.
2. Diet.
3. Location of dwellings.
4. Cleanliness of surroundings.
5. Drinking-water.
6. Sleeping-apartments.
7. Mental influences.

The Farmer's Work.

This subject is naturally divided into two branches, viz.: 1st, the work of the farmers themselves; 2d, of their wives and children.

In order to obtain more definite information upon the first of these topics than could be conveyed in the answers to the 4th question, the following was put to our correspondents:—

6th Question. "Are farmers apt to be injured by the nature or amount of their work? If so, in what way?"

To this, eight correspondents reply in the negative, twelve return a qualified negative, and twenty-six answer in the

affirmative, with more or less of an explanation, as desired in the second part of the question. Three make no reply.

The affirmative answers are these :—

Bonney.—Yes; by heavy lifting, working under excitement. They know no limit to the hours of labor, except the want of light to work by, when work pushes. And by exposure of the body, after debility from exhausting labor.

W. S. Brown.—Yes; but not so much as formerly. The introduction of threshing, mowing and other machines has proved beneficial. In New England, the work is performed in a shorter period of months, necessitating long hours of hard labor. Pitching hay, loading manure, etc., from the exposure and violent exertion, sometimes result in hernia or lung diseases. More work is done during winter—preparatory work—than formerly.

Cowdrey.—Heavy lifting often produces hernia and enlargement of heart.

Clark.—By lifting to great heights, producing hernia; perhaps by some other strain. Dislocations are frequent. Lifting too severely has caused kidney difficulties, affections of the bladder, and urinary troubles generally.

Collins.—Too many hours, and exposure to bad weather.

Dickson.—Are injured by long-continued labor, working fourteen and sixteen hours per day; also by not allowing any time for digestion, after full meals.

Haskell.—In extreme hot weather, they may be.

Hawkes.—I know of nothing in the nature of farmers' work that is necessarily injurious or unhealthy; yet urgency in execution, under unfavorable aspects, does often render extra exertion necessary, and even unavoidable, from which injurious consequences to the general health may, and often do, follow. I have many times seen sad examples of this kind.

Hills.—I think so. By exposure to cold and wet (as in ditching, lumbering and setting tobacco); by overwork at certain times, when there is much work to be done, and help is scarce; by working early and late, not getting sufficient sleep to recuperate the vital powers. Yet there are some portions of the year when there is little to do, and farmers have a leisure time, which probably balances the overwork at other times.

Hitchcock.—Perhaps in a few instances from both; but I think the injury to their health oftener comes from a distaste for the work, or from discouragement arising from small incomes, and slow progress in improving their financial and social condition.

Hosmer.—I should say that the large amount of monotonous, hard work which is likely to fall to the lot of a farmer, tends to use him up. I think he suffers for the lack of some healthy cerebral excitement.

Jones.—Injured in the excessive labor, which becomes exhausting to the physical powers.

Kittredge.—In hot weather, by overexertion and exposure.

Mercer.—Farmers are injured by the amount of work.

Miller.—Perhaps by its amount, with its attending exposure; not by its nature.

Morse.—Many farmers are injured by the long hours of harvesting time. Generally, farmers work more hours than any other class, for eight months of the year, though, in this respect, there is a great improvement since the invention of labor-saving tools, viz., the mower, the tedder and the horse-rake. Still, now, a farmer is expected to do a day's work of ten or eleven hours, and then do his "chores" besides, which often occupy him an hour in the morning and an hour in the evening.

Paddock.—I think they are. At times, they work very hard, and, when physically exhausted, they eat very heartily. They are not sufficiently protected with clothing.

Paine.—The amount of their work, especially in harvest-time, is often too great.

Phillips.—The labor often requires the farmer to sustain excessive fatigue for weeks, without intermission or relaxation, compelling him to rise long before the sun, and to continue work till dark, which produces extreme prostration of the system.

Pickett.—In some instances, by hard lifting, or from pitching hay, grain, &c.

Reynolds.—Yes; by the constant labor, without relaxation.

Scammell.—They have too much hard work, at times, and, occasionally, too much exposure, both to heat and cold.

Smith.—By working beyond physical capacity. Hardly a farmer, over forty, but has muscles stiffened with, as they say, rheumatism. It is probably overwork.

Webster.—By excessive work, at certain seasons; fourteen or fifteen hours a day, in haying-time.

Wilcox.—As a class, the condition of agriculturists, in these respects, is much more favorable than formerly, from the introduction of labor-saving machinery. Some of the least wealthy farmers are overworked during the planting, hoeing, haying and harvesting seasons.

Winsor.—Yes, in the "driving" season, *e. g.*, haying, planting, and, in the case of market-gardeners, during eight out of the twelve months,—causing emaciation, weak and painful digestion, loss of appetite and debility, with headache.

The qualified negatives are as follows:—

L. S. Adams.—No, except from want of prudence and caution.

Beane.—Not as a rule. There are exceptions; but, for the most part, it is positively healthful.

F. D. Brown.—Not specially so. Perhaps it may be said of them, that they do too much work in summer, and too little in winter.

Davis.—I think not specially so, though they are liable to some accidents, such as cuts from various implements or machines, and injuries from animals.

Eastman.—As a rule, I think not.

Fisk.—No; unless it be by excessive labor, in some instances.

Haddock.—No; unless in working too many hours, to get "day's works" out of those they employ.

Hartwell.—Not necessarily so, bnt none from lack of system. Generally, their work is not injurious, either in nature or amount.

Lawrence.—I think not, except where there is a lack of forethought, and general stupidity and ignorance.

Seymour.—They are not, except in isolated instances, from avarice, when they overwork and underfeed themselves.

Taylor.—Not in this community; but a farmer with the care of large possessions must necessarily be incapacitated for much labor at the close of the season.

Vermilye.—The general health is liable to injury; but, as a class, I should not think them more prone to accidents, nor as much, as most mechanics or manufacturers.

That the labors of the farmer not infrequently prove physically injurious, the foregoing correspondence affords ample evidence; but it is also clear that it is less the *nature* of the work than its *amount*, combined with exposure to the weather, that works the mischief. The farmer's active, out-door life, his varied duties, affording exercise to every muscle, naturally tend to develop and harden his frame, to give him both strength and endurance, and to make him a very Hercules in comparison with his city-bred cousin. Such is, in fact, the normal condition of the farmer who works within reasonable bounds, and is not obliged to sacrifice himself to his crops. But labor, carried too far, exhausts and enfeebles the frame; and it is too often the case that the New England farmer becomes broken down by an excess of those labors, than

which, pursued in moderation, nothing could be more salutary. The season, in our State, is short, and most of the operations of the year must be crowded into a period of five months; labor is high, and the small farmer is obliged to do himself the work of two or three men. Moreover, on small farms,—especially when rough and hilly, as they are very apt to be in this State,—labor-saving machinery is less available than upon the prairies of the West. The farmer must therefore toil unceasingly from dawn until dark,—in spring, laboriously guiding the plough through the stony soil, pitching manure,—a terribly exhausting task,—and rushing through with the planting, for which our short spring barely allows an opportunity; in summer, bestowing upon the haying as much labor, calculation and anxiety as would suffice to win a battle, swinging the scythe through the long, hot days of June, and, in getting in the loads before the showers, performing a species of blockade-running requiring an expenditure of force measured, not by the capacity of the man, but by the urgency of the need. In the excitement of the moment, prodigies of pitching are done, too often entailing a rupture or a strained back, perhaps producing a life-long disability. Then, when the hay is in, and the rain comes flooding down, the weary farmer, reeking with perspiration, naturally places himself in a draught of cool air, whereby a chill may be contracted, the precursor of lung fever or some other inflammatory affection. Next, he rounds his shoulders and stiffens his back with the hoeing; and, in gathering-in the harvest, before the early frosts, there is a hurry and a drive that is almost equal to haying over again.

The winter is, comparatively, a season of rest; but there are the animals to be fed and cared for, all sorts of "chores" and no end of carpentering jobs to be done, besides hauling wood, which forms a part of the winter occupation of the majority of farmers, and is another of the severe strains upon their constitutions. In loading up his sled, the farmer most likely gets into a free perspiration, followed by a chill to the very bone when he rides home with his load. In unloading there is another heating process, and, in driving back to the wood-lot, in the keen mid-winter air, another chill. No wonder our correspondents speak of rheumatism as

the most frequent of farmers' diseases, and acute lung affections as next on the list.

There are other of the farmers' duties involving overwork and exposure. Such are ditching, laying stone wall, threshing (for the flail is not yet entirely discarded), working out taxes on the highway, and taking produce to market in all weathers. To the man bred to labor, these may all be strictly harmless pursuits; but it is the hurry and drive incidental to an overwhelming array of arduous duties that renders them harmful.

Farmers are also liable to certain bodily injuries, as cuts from scythes and axes, kicks from horses, fractures and contusions received in falls from loads or hay-mows, and strains in lifting heavy weights. Frost-bite and sun-stroke are also frequent enough, as well as hernia and varicose veins as the result of too laborious work. In order to ascertain the comparative frequency of such injuries, and especially of the two last-named affections, this question has been asked of our correspondents :—

7th Question. "Is the work of the farmer specially productive of hernia, varicose veins, or any other injuries?"

The answers may be classified as follows :—

No, ...	19
Not more so than other equally laborious occupations,	13
Yes, ...	14
Don't know, ...	3
	49

Of negative, or partly negative, answers, the following are examples :—

Hitchcock.—Not so much as lumbering or stone-mason work, or some other very laborious occupations.

Kimball.—Perhaps of hernia; but I am not sure even of this.

Lawrence.—Of course more so than some employments; but many other occupations are much more productive of these complaints.

Miller.—Perhaps of hernia; of none other except the effects of chronic rheumatism.

Parks.—No more than any other employment that requires lifting or violent exertion.

Seymour.—Not specially; and yet I know of many cases of hernia from sudden straining. It would have been the same, probably, had the individuals been simply laborers. The *work* is not productive of such results.

Smith.—I have seen many cases among farmers of hernia, and, with women, of varicose veins; yet, I could hardly say it was "specially productive."

S. E. Stone.—I think varicose veins rather common among farmers, but, perhaps, not more so than among those whose occupations keep them as much on their feet.

Taylor.—No. Think cases are on record of hernia produced among farmers by violent exertion,—such as pitching and raking hay.

Webster.—I think not, with the exception of laying stone wall.

Wheeler.—I do not find hernia or varicose veins so frequently among farmers as I do among those who follow other occupations. They may receive wounds from cutting instruments, or injuries by falling from loaded carts, or by vicious animals.

Of affirmative answers, the following may be cited :—

Bonney.—Hernia is common, varicose veins somewhat so, fractures and wounds frequent from the use of teams, sledding, axes, etc., especially in winter, when wood and timber are got.

W. S. Brown.—Yes; but on large farms, where modern machinery is used, not so much so as was the case thirty years ago.

Fisk.—Of hernia, I should say *yes.*

Hartwell.—Think I observe more cases of varicose veins among farmers than any other class; but not of other injuries or hernia.

Hawkes.—I have known many cases of hernia produced by pitching hay and lifting stone. I am not aware that farmers are particularly subject to varicose veins; but their diversified business subjects them to almost every form of accidental injury. I think the greatest number of injuries among farmers comes from the use of the axe, in different ways.

Paine.—I think it is, in regard to hernia, and possibly varicose veins.

Winsor.—Of *sprains,* especially to the lower half of the back.

While a majority of our correspondents testify that these injuries are not uncommon among farmers, a majority also deny that farmers are *specially* liable to them. It seems to us that both of these opinions are correct; for it is not the *nature* of the work, but the physical *labor* that produces them. And there are other occupations as laborious as farming, or more so, in which hernia, varicose veins, sprains, etc., are quite

as frequent. The farmer suffers from them in proportion as his labors are in excess of his physical strength.

THE WORK OF THE WIVES AND CHILDREN OF FARMERS.

To obtain information upon this second branch of the labor question, the next interrogatory was made.

8th Question. "Do the wives and children of farmers suffer from overwork?"

The answers may be tabulated as follows:—

Yes.	Both wives and children,	25	
	Especially wives,	3	
	Wives only,	10	
		—	38
No,			11
Total,			49

Such answers as "occasionally," "not generally" and "not as a class," are considered as negatives.

Over three-quarters of our correspondents, therefore, believe farmers' wives to be overworked; and half of them assert that the same is true of the children.

The following answers are selected as possessing the most interest:—

Bonney.—They do. The wives directly, from the care of a large family of workmen, the making of cheese, butter, etc., long days and short nights, insufficient sleep, and want of amusement. The children, from the hereditary influence coming from parents overworked, and consequently in poor condition to beget healthy children. The latter have also frequently to participate in the labor of the parents at too tender an age.

F. D. Brown.—I have no doubt the wives of many farmers are overworked, and perhaps some children; but, as a general rule, the children are not, in these days.

W. S. Brown.—Yes; many of them, especially the wives, on small farms.

Clark.—When too ambitious they often do. Children of farmers are often compelled to do too much, while they have not the strength to spare for the work. Growth is thus retarded. This is where many farmers fail in their duty to their children.

Davis.—Yes; not ordinarily from severity of the labor, but from too many hours of it. The wife is often the first person in the house to get up in the

morning, and the last to go to bed at night, being, in the meantime, constantly busy. In many cases, the children, while growing up, work daily from sunrise to dark, and, in order to get the recreation that they must have, are obliged to infringe on the time when they should be resting.

Haddock.—Yes; they bear more than their share of the burden.

Hawkes.—So far as my observation goes, the wives and children of farmers, in this county, do not begin to compare, in point of laborious servitude, with the wives and children about our manufacturing establishments; yet the operative class of farmers' wives and children suffer privations, and are subject to the ills of out-door exposure more than most other classes of people.

Hills.—Yes; many times, especially where the dairy work is done at home, on the larger farms. The women, in this region, do a great deal of braiding palm-leaf hats in addition to their housework, which is an injury to them, as I have formerly explained in my communications.

Hitchcock.—I think the wives frequently do. The children, in these modern times, escape to some lighter, or more agreeable, occupation.

Kimball.—I think it probable that the wives of farmers are injured by overwork. It is exceedingly difficult, in country places, to hire indoor help, and, from this fact, the tasks of farmers' wives are undoubtedly burdensome.

Lawrence.—Yes, when cheese and butter are made; otherwise, I think not.

Mercer.—The wives suffer, in many cases, from overwork during their pregnancies, which is a productive cause, in later life, of varicose veins and uterine displacements.

Morse.—Wives, especially during pregnancy and lactation, suffer very much. They are often worn-out by suckling and work at the same time. If a farmer wishes to raise a fine calf or a fine colt he never works the mother during pregnancy, or while suckling. If he wishes a large quantity of good milk, he will never allow his cow to be driven or worried. The farmer's *wife*, while suckling her child, generally does all her work, and has the care of the child in addition. Her milk does not agree with the child; it cries nights, whereby she is deprived of the necessary amount of sleep, and the result is, she grows prematurely old and worn-out. Besides, a farmer's wife's work is never done; she often works sixteen and seventeen hours a day.

Paddock.—The work of the farmer's wife is never done. She has scarcely any time for social or other recreation; and the want of good nursing and care, during and after confinement, is the chief cause of illness and poor health of the wife. The children are left to "grow up themselves," as the saying is, and the weak and puny suffer from neglect, and improper food.

Peck.—Yes; there is a general want of constitutional vigor among the females and children of the original New England stock at the present day, which is sad to contemplate. It will lead to the extinction of the race, here in New England, at no distant day, if not counteracted. In almost seventy-five years of observation, it is to me a marked and mournful fact.

Pickett.—At some seasons of the year, especially during the heat of summer, the dairy and other duties call for unremitted toil, when the system is least able to endure it.

Taylor.—Oftentimes. Those who conduct large dairies are overburdened with work. Children are deprived of their natural sleep to help prepare the farm products to go to market.

Winsor.—Wives and grown-up daughters do so suffer.

To these professional opinions we may add the equally valuable testimony of the Hon. H. F. French, whom we have already quoted. He writes :—

Farmers' wives work too hard for health. Help is scarce, and the mother, with her household cares, want of sufficient sleep (especially when she has small children), and her responsibility as the lady of the house, bears too heavy a burden, and she and her offspring must suffer by it. As to the children, the daughters give what help they can, consistently with getting an education, which seems to be the chief end of woman with us. They are not hurt by overwork, though often by overstudy. The boys do not suffer from overwork as much as the father and mother.

This correspondence makes it evident that the duties of the farmer's wife are apt to be far greater than ought to be exacted of her. When, to the bearing and rearing of children, is added general housework, including the cooking for several farm-laborers, besides her own family; and to this is further added the care of a dairy, a woman's life becomes, in truth, a slavery, and she who can perform these tasks without seriously impairing her health, must be possessed of a constitution superior to that which is commonly allotted to woman. The worst evil is overwork during pregnancy and lactation, whereby are engendered uterine disease in various forms and generally enfeebled physical powers, while the children are feeble and puny, and, if they survive the perils of infancy, enter upon life without the fair start which nature has a right to expect. Upon this subject we call special attention to the letter of Dr. Morse, just quoted, as stating the truth in a very clear and forcible way. Although it is naturally the wives of the poorest farmers who suffer the most, the evil extends to the more wealthy, owing, in great part to the difficulty, mentioned by Dr. Kimball and Mr. French, of procuring, in the country, female "help."

The children of farmers are less likely to be overworked than the wives, although we have abundant testimony that they are so in many cases. The comparison used by Dr. Morse, of the treatment received by the farmer's wife and

child with that accorded to his cow and suckling calf or colt, may be carried still further in its application to the later development of the child. The calf or colt, of good stock, receives, after weaning, the most tender care; its food is carefully prepared, its exercise is carefully regulated, it is protected from the inclemency of the weather, and the colt is not put to work until his frame is well developed, and, in his earlier years, the greatest care is taken that he is not worked beyond his strength. The farmer's child, however, is less fortunate, for, while apt to be neglected in early childhood, he is too often set at work at an age when nature designed that he should do nothing but play, eat and sleep. As a consequence, he becomes stunted in body and mind; and many a bright and promising boy is, by a short-sighted thrift on the part of the parents, converted into a stupid drudge.

To prove that our farmers and their families are overworked is far easier than to provide a remedy for the evil. The cause is usually *poverty* or *thrift*. In the former case, the farmer is barely able, with the combined and incessant labors of himself and family, to feed and clothe his household in the most meagre manner, and come out square at the end of the year. In many such cases, we conceive it to be a duty that the farmer owes to himself and his family, to give up the farm, and work for wages. A man who has been working a small farm the past year has informed me that, with his utmost efforts, and the aid of his three boys, he has made just a third of what he earned as wages the previous year, when he worked in a cheese-factory. Many a poor and disheartened farmer would, as a farm-laborer, be comfortable, healthy and happy; but the New England race loves independence, and the true Yankee would rather be a farmer than a laborer, even though his farm is heavily mortgaged, the land worn-out, and himself and his family broken down with excessive toil. For the perpetuity and vigor of the race, it would be better if a few of the poorest class of farmers would sacrifice a little of their traditional pride in independence and social position.

But poverty is less frequently a cause of overwork than *thrift*, carried to a mistaken extent. The well-to-do farmer, wishing to lay by as much as possible, will often overwork

himself, his wife, and sometimes his children. He economizes by hiring as few hands as possible, "wastes" no money on food, clothing and domestic comforts, and is slow to purchase "new-fangled machines" for saving labor, because they are expensive. But the *wives* of this class of farmers are far more likely to be overworked than the farmers themselves. The New England farmer's wife is capable, energetic and ambitious, while she has usually but a moderate share of physical strength. She desires to outshine her neighbors, both in her housekeeping and butter-making; she sends her daughters to school, when they might be a great assistance to her at home, and sometimes when more work and less study would be better for them; and she employs little or no "help," because wages are high, and she wishes to save expense. Her husband is proud of his "smart" wife, boasts of her capability, and stimulates her to still further tax her powers. She often, therefore, works even harder than the wife of the poor farmer, and under the same disadvantages of the exhausting cares incident to motherhood. It is, indeed, true, that our farmers' wives fare better than those of the "Pennsylvania Dutch" farmers, who perform laborious field-work, while their lazy husbands smoke their pipes in the shade, and grow rich upon the products of their detestable domestic tyranny. But our women have a finer organization, and less animal strength than they, and may easily succumb to labors which, to their degraded German sisters, would constitute but a mild species of serfdom.

The children of our thriving farmers, especially the daughters, are less likely to suffer from overwork than those in more straitened circumstances.

The remedy for the tendency to overwork among farmers, when not due to absolute poverty, lies in a better understanding of the value of health, the laws by which it is governed, and the means whereby it may be preserved. The farmer should also understand that it is not true economy to lay up money, when the process of accumulating it makes his wife an invalid, and necessitates the expenditure of a much larger sum for sickness. More labor-saving machinery should likewise be introduced upon the farm. For small farms, where the more expensive machinery is not available,

cheaper substitutes would doubtless be invented, were inventive genius turned in that direction through the interest and liberality of agricultural societies. Since overwork is largely due to the scarcity and consequent high price of labor, it must be remedied by the perfection and low price of machinery.

By no means would we encourage our farmers to be lazy; we respect and honor them for their industry and frugality; but we do wish them all to know and preserve the happy medium where health and happiness are neither assailed, on the one hand by sloth, nor on the other by too severe labor.

The Farmer's Diet.

Dr. Derby's paper upon "The Food of the People of Massachusetts," in the Fourth Annual Report of the State Board of Health, embraces nearly all that can be said upon this subject. The letters from correspondents, which he cites, include many from farming towns, and, in his summing up, the farmers receive as much attention as any other class. His conclusions, which apply to the great majority of the people of Massachusetts, of all classes and occupations, may be briefly stated as follows:—

1. Good bread is scarce, and is too often made with some unwholesome substitute for yeast.
2. There is too little variety in food.
3. Meat is too apt to be fried.
4. Baked beans and salt pork, although a highly nutritious dish, are too generally used, being indigestible for many persons.
5. Pastry and cakes are used to a highly injurious extent.
6. Too little time is allotted for meals.
7. Coffee and tea, especially the latter, are too freely used as beverages.
8. Water is used to excess.

To this paper we can do no more than add the opinions of some of our correspondents, which, as they refer exclusively to the diet of farmers, possess some additional and special interest.

9th Question.—Are farmers and their families injured in health by the use of improper, insufficient or badly-cooked food? What improvement could you suggest in their diet?

A few correspondents answer, "No," and think no improvement necessary; but the great majority find the farmers' diet, in some way or other, not entirely satisfactory.

We select the following replies:—

L. S. Adams.—Some substitute pies and cakes for better and more nourishing food, to their injury.

Beane.—A greater amount of *fresh meat* would be decidedly beneficial, especially during fall and winter.

Bonney.—They fry their food too much. Food is apt to be coarse; and, with some, too much pork and potatoes are eaten. There might be improvement in the method of cooking; but there has been great change in this matter, and I would say that they live pretty well.

F. D. Brown.—Not as a general rule. In this vicinity, they live well. If I were to suggest an improvement in their cooking, it would be to bake and boil more, and fry less, of their meat.

W. S. Brown.—Yes; the food is often improper; seldom insufficient, but often badly cooked. The substitution of fresh meats, fish, &c., for part of the salted meat, and the addition of cooked fruit to the mid-day meal (alone, not in the form of pies) would be a great improvement. Meat should be boiled, not fried. Eggs should be used more frequently.

Burgess.—Yes; I suggest more, and better, and better-cooked *fresh* meat, but especially better bread and better butter.

Clark.—Their food is most wholesome. Excluding the use of pork and buckwheat, I would make no other improvement, except as regards *time* of eating, and *quantity* at a time.

Collins.—I think they do; and would suggest the use of more beef and mutton; also that proper lecturers upon the subject be appointed to visit the different public schools in the State.

Crowell.—Yes; more *fresh* animal food; less of *frying;* more attention given to the *art* of cooking. Poor bread is often found upon the farmer's table.

Davis.—Yes; I would suggest greater variety, especially more fresh meats and vegetables.

Dickson.—More meat, especially fresh; more fish and less pie.

Goddard.—Think they use too much salt meat and salt fish. Their food seems abundant and well cooked.

Haddock.—Think they live better than any other class of laborers.

Hartwell.—Improper and badly-cooked food, yes. Among the poorer classes, too much vegetable, to the exclusion of meat-diet; the latter of poor quality. Food is not sufficiently cooked; this I regard the greatest evil, as regards diet, and the most important to be corrected. Then there is not variety in the articles used for food, farmers being too apt to follow the "take-what-comes-along" principle.

Haskell.—Not so much as other laboring men.

Hills.—Probably they are, by improper, and sometimes by badly-cooked food; seldom, in this region from insufficient food, unless it may be in variety. I suggest that less pork be used, and more of other kinds of meat, among adults. Less of "trash" (such as green apples and other fruits, as well as vegetables) for children. Less feeding infants with solid food until they are one and a half or two years old.

Hitchcock.—Generally, food is good in quality, and sufficient in quantity; but meats are very often badly cooked by frying and other abominable methods; and sometimes bread is badly made.

Hosmer.—I think they are. They should drink less tea, eat better bread, and have more fresh meats, *rarely* cooked.

Jones.—They should have more fresh butcher's meat, and less Indian and rye bread.

Kimball.—Perhaps the food in most farmers' families is wanting in variety; but I believe the cooking, as a general rule, is as good or better than in the families of artisans and operatives.

Kittredge.—Our farmers nearly all live well. They eat in too much haste.

Lawrence.—Yes; more by poor cookery than from any other cause. As a general thing, I get nothing fit to eat among the farmers. I suggest the use of less alkali, and *broiling* steaks, instead of *frying* them to a crisp in lard.

Miller.—Yes; improve by adding variety and banishing pie-crusts, cakes cooked in lard, all rich pastries and fried meats, and using less of pork.

Morse.—The food is sufficient, but too often poorly cooked. The bread is generally poor, heavy and sour, often made with cream-tartar and saleratus or soda. Improvements; good yeast-bread, less doughnuts and pies, and the entire abolition of the *detestable, infernal* frying-pan; more fresh meat, a greater variety of vegetables and less corned meat and boiled potatoes.

Paddock.—The food of farmers is usually soaked in fat. Beef-steak is fried to a crisp in fat, nearly all other meats are fried, and I think a larger proportion of farmers are dyspeptic than any other class. They need better bread, rare-cooked meats, less fat and grease.

Scammell.—No; yet they may eat too much pork, because fresh beef is not easily accessible.

L. R. Stone.—Not more than all laboring people. I should say, as to diet, better bread, no pies or doughnuts, no fried meats, more fresh fruits and vegetables, more fresh meat and milk, and baked beans and corn-bread much less frequently.

S. E. Stone.—Food is apt to be poorly cooked and the variety too limited. I would suggest a less stinted use of their own productions, more milk, eggs and chickens to be consumed at home, a greater variety of vegetables to be cultivated, and, above all, banish the idea that vegetables and ripe fruits are unhealthy. That cooking be reformed gradually, and the importance of good bread, in its varieties, be encouraged; palatable stews and broiled meats to be substituted for fried dishes, as being more economical, as well as more digestible.

Taylor.—The general diet in most of the families entirely excludes meat. The "Graham" idea is prevalent, which, although good enough in its way, is not sufficient, in my opinion, to sustain a rugged body. Should prohibit eating lunch in the hay-field. Irregular meals are a great cause of disease.

Vermilye.—Yes; would suggest the abstinence from pork and salt meats, at least in summer, with the use of fresh meat (roasted or baked), milk, a variety of vegetables and fruits, and sweet wheaten bread. Above all, a reversal of the usual order of "selling the best and keeping the worst for home consumption."

Webster.—Yes; farmers' wives are not so good cooks as women living in towns and cities. They should use the frying-pan less, use yeast instead of alkalies for bread-making, eat less pastry, take more time for meals.

Wilcox.—I think their food is seldom insufficient in quantity, but is often of an improper kind, and generally badly cooked. With many farmers, salted meat is an almost constant article of diet; and, in the case of pork, usually fried. In many districts, contiguous to villages, fresh meat might be alternated. Boiling or roasting might usually be substituted for frying. The brown varieties of bread or well-kneaded rye or wheat bread might be used in the place of the too common winter course of hot buckwheat griddle-cakes, and the summer one of hot "short-cakes," "raised" with saleratus, and for the everlasting American pastry.

Winsor—No class suffers more in this way among us. Ill-made bread, hot from first baking, *pies at every meal*, too little fresh meat, too much salted meat and fish, great preponderance of fried food, swimming in pork-fat; amazingly little use of milk and eggs in *simple shapes* (too much in cake); rarely any breadstuffs except finest wheaten flour ("Boston brown-bread" is an exception); tea in excess, and in consequence the women often suffer from eating too little, which is the only way in which the farming-class suffers from "insufficient food." As to my suggestions for improvement in diet, they are foreshadowed in my censure. I would have "raised" and thoroughly-kneaded bread (not *fresh*, till we learn the European secret in this matter, and can make bread which can with impunity be eaten hot

from the oven), of coarse flour, and oftener "mixed," *i. e.*, with other grains joined with wheat. More fresh, yet duly kept, beef and mutton; never *fried.* No pastry nor rich cake. No greasy food (as contrasted with unmelted butter, or fat in its proper relation to lean). No tea at dinner or between meals; cider or home-brewed beer might well be used at dinner, in addition to water. Much more milk and eggs, (not in cake) used. More fruit and vegetables; *nothing fried.* No meat at supper. *No hurry at meals;* too much cannot be said of the mischief caused by our national habit of bolting food, without any approach to social life at table. More fun and recreation.

The foregoing opinions are in very striking accord with the conclusions reached by Dr. Derby. Regarding the *frying* propensities of our farmers, there is but one opinion, and that a very strong one; *pies* also meet with decided disapproval, and *bread* is not considered up to the standard. The suggestions for improvement are admirable, and worthy of heed. The general opinion is: more fresh, and less salt meat; less frying and more boiling, broiling and roasting; a greater variety of vegetables and fruits; less pies and cakes; more wholesome, well-kneaded bread, raised with yeast; less tea.

It is a somewhat singular fact, that farmers live so little upon their own productions. They send their fresh vegetables, fruits, eggs and poultry to market, and live themselves upon salt pork, pies and saleratus bread. This is not true of all, by any means, but it is of many. It is a part of the Yankee thrift, which sells everything that is salable, and lives on what is left, with the addition of such other necessities as are cheapest. The farmer himself, with his active out-door life, can digest almost anything, and, to a certain limit, thrives upon his wretched diet; but the wife and daughters, living indoors, grow pale and dyspeptic, because, with an abundance of wholesome food close at hand, they pass it by for that which scarcely deserves, so far as their necessities are concerned, the name of food. Doubtless this is in part to be accounted for by the distaste which people are apt to acquire for such articles of food as they themselves produce. An illustration of this is found in the exclamation we have several times heard made by patients for whom we were ordering milk diet,—"Oh! I was raised on a farm, and never drink milk"; but the chief cause is, doubtless, economy. Of these suggestions, the hardest to enforce is an increase of fresh meat, for this must usually be bought, and is high-

priced. When an animal is killed, it is sent to market, being considered too valuable for home consumption. But the farmers may rest assured that the addition of fresh meat, in greater abundance and variety, to their bill of fare, in the form of good soups, stews, roasts, boiled pieces and *broiled* steaks, would prove, in the end, a most *economical extravagance.* It is not necessary to buy porter-house steaks; the cheaper parts, with proper cooking, are equally nourishing. Beef and mutton are the best meats; veal and pork are not fit for staples.

The poor cooking which prevails among our farmers, as well as all other classes, doubtless results from *hurry;* frying takes but little time and trouble, saleratus bread can be made in a "jiffy," and bread and pastry are heavy and sodden, because kneading requires time. The *overwork* of farmers' wives is therefore, in great part, responsible for inferiority of farmers' diet. It is very important that our farmers' daughters (as well, in fact, as all young women in the State) should cultivate the art of good cooking. With knowledge and skill, there are many articles of food which require no more time to be well-made than poorly-made. For the others, more time must be taken, or quicker, but good, methods discovered. Dr. Derby aptly remarks that "no improvements in the manner of preparing food for daily use stand the least chance of adoption in Massachusetts, unless they are labor-saving." May some good genius send us a professor of good, simple, economical and rapid cookery, who will be to the great mass of our people what Prof. Blot is to the favored few. Profiting by his instructions, the farmers' wives of the future will prepare viands which shall put vigor into the frames of their children and roses into their cheeks, and before which dyspepsia and its attendant ills shall flee like the mists before the rising sun.

The subject of *pork* as an article of diet is so well worthy of investigation that a special question relating to it has been put to our correspondents, viz.:—

10th Question. "Do farmers in your neighborhood live much upon *pork?* If so, have you observed any ill effects resulting from this diet?"

To the first part of the question, 30 answered "Yes" and 16 "No," three making no reply; seven qualify their answers by adding, "less than formerly." To the second clause, nine reply that they have observed injurious effects; and 20, that they have not. One even asserts that its use is beneficial. Of those who consider pork injurious, four specify, as its result, dyspepsia, three scrofula, and one trichina. Nobody mentions having observed tape-worm or consumption among its effects.

We must admit being somewhat surprised at this result of our inquiries, since we believe pork to be discountenanced by the majority of the profession, including most of the good authorities, for several reasons, viz.: 1st, it is slow of digestion; 2d, it contains an excess of fat; 3d, it may, if imperfectly cooked, produce trichiniasis and tape-worm; and 4th, there are good reasons for believing that a pork diet increases the liability to consumption and scrofula.

The 3d and 4th objections to pork will seldom obtain among farmers, who usually raise their own pork, and would not be likely to eat it themselves if found to be *measly*, or to be spotted with the minute whitish dots, indicating the presence of *trichina spiralis*. Even the 1st and 2d objections would apply less to the farmers themselves than to persons of sedentary habits; for, as we have already observed, with their active life in the open air, they can digest almost anything. The females of their families, however, must necessarily suffer from dyspepsia, at least from the too abundant use of pork.

A few extracts from our correspondents' letters will be subjoined, in which a very radical difference of opinion will be remarked:—

Bonney.—Twenty-five or thirty years back, they did. Now, they use much more beef and mutton. I think that, in those days, there was evidence of mal-nutrition to a greater degree than now; dyspepsia was more common; there were more rickety children, and scrofula was much more talked about. There is less of phthisis, and life is longer. Much of this is, of course, to be attributed to other causes, but change of diet has had its influence.

W. S. Brown.—Yes; pork, as a general rule, is injurious to children and old people. Strong, healthy, middle-aged or young people, working in the open air, seem to be able to digest it. I think the reason it causes dyspepsia in children, and old and feeble persons, is on account of the large amount of fat which permeates the lean meat of pork.

Crowell.—A good deal of pork, especially salt pork and bacon. No special results; one cause of ill-health in persons of scrofulous tendencies.

Goddard.—Not very much; less than formerly. Pork seems to derange the digestive organs, and perhaps prepares the system, to some extent, for the bilious and typhoid fevers. I preach against pork.

Haskell.—Not so much as our fishermen and seafaring men generally. In this climate, and when we consider the effects of the fats in consumptive cases, the prejudice against pork seems unfounded. When families use pork, and nothing else, as animal food, it is the *nothing else* that works the mischief. Without pork, no vessel could sail the ocean.

Hitchcock.—I think it is an open question whether or not pork is, in the long run, a wholesome food.

Kimball.—Farmers, in autumn and winter, use pork as an article of food, to the exclusion of other meats; but I have never observed injury from this diet, in this vicinity.

Lawrence.—Much pork is eaten, and I have observed no bad effects. On the contrary, scrofula and consumption are cured by eating pork.

Morse.—They do, on pork of their own fattening. I have never known of any injury from using healthy, home-fatted pork. An excess of pork and lard may be injurious, and these, always used in the frying-pan, I know to be decidedly injurious.

Wilcox.—It is eaten a great deal, especially in those neighborhoods not of ready access to the markets, or away from the route of the butchers' carts. I saw several cases of trichinasis in one family, recently, caused by the use of raw Western pork. I have, in several instances, seen extending ulcers heal by simple abstinence from the usual diet of fried salt pork.

Winsor.—They do, more than on any other meat,—both fresh and salt, lean and fat; and the women and children suffer, in consequence, as do the men, from the various forms of fried pork. But it should be remembered that, for strong men, living in the open air, in active exercise, well-cooked pork is the most *sustaining* of all meats,—partly, at least, because of its slow digestion. In such men a sense of emptiness ("goneness") results from feeding exclusively on quickly-digested food, however nutritious. "Pork sticks by the rib; I can work on pork; darn your venison and trout," was the expressive remark of an athletic hunter and lumberman to me, in the Adirondacks, twenty years ago. This supposes the pork to be sound. I have never had a case of tape-worm in a farmer.

Under the head of Diet may be considered the use of *stimulants*. To ascertain how freely these are used among our farmers, this question was asked :—

11th Question. "Are farmers in your neighborhood apt to be intemperate?"

In the answers to these questions, we find a remarkable and gratifying unanimity. Of forty-eight who reply, forty-two say "no," three say "yes," and three "not more than other classes."

This is an exhibit which may well excite our admiration, and one in which the farmers themselves may well be pardoned for taking an honest pride. In their temperate habits lies, in a large degree, the secret of their strong influence in the community. It is the result of high principle, aided, no doubt, by their remoteness from villages and want of leisure to spend in the rum-shops. It is quite probable, also, that their general use of *cider* as a beverage may have an influence, as shown by Dr. Bowditch, in the Third Annual Report of the State Board of Health, in preventing the use of strong drinks.

A few correspondents express more extended views than the mere monosyllabic reply, and such we will extract:—

F. D. Brown.—I do not think they are; years ago, they were more intemperate than now.

W. S. Brown.—Not more so than other people; on the whole, I should say, rather less so.

Haddock.—No; not just with us. Most are very temperate; a large proportion are total-abstinence men.

Haskell.—No; I do not know of an intemperate farmer.

Hills.—Not as a class. Some cases of intemperance, who will always drink to excess, if they can get liquor; but the majority are quite temperate. Many use liquor, and very many cider, but use it temperately. I make a distinction between *temperance* and *abstinence.*

Hitchcock.—Not as a class. There are scattered about a few *so-called* farmers that are intemperate; and I have observed many times that, among these poor and petty farmers, the intemperance seems to be hereditary.

Kimball.—Farmers are the most temperate class in this community.

Kittredge.—Not so much so as twenty-five years ago.

Lawrence.—Some of our farmers die drunkards; but, as a general thing, are sober and temperate.

Peck.—Formerly (say fifty to sixty years ago) there was an awful amount of spirit-drinking, which, if it had not been, in a measure, arrested, in the providence of God, by the effects of the temperance societies, would have produced effects sad to contemplate. There is too much used here at present, but I think there is much less intemperance among farmers than in a manufacturing community.

Taylor.—They all like their *cider;* but the use of alcoholic stimulants is not general.

The other side of the question is represented by the following:—

Smith.—I think farmers drink altogether too much hard cider. It may be only an impression. Has this drinking hard cider any connection with rheumatism?

Burgess.—They are apt to drink, but not to excess, for they are too poor.

Several of these replies speak of an improvement, in this respect, during the present generation. The tenure of the whole correspondence goes very decidedly to show that our farmers are quite as temperate as any class of the community, and perhaps stand, in this respect, at the very head of the list. This is a fact which must contribute immeasurably to the health, happiness and prosperity of our farming community, and must counterbalance, to a great extent, many of the injurious influences to which they are subjected.

Location of Farm-houses.

In building a farm-house, the considerations which ordinarily determine its site are, convenient access to water, to the farm-buildings, and the road. High situations are apt to be avoided, because windy, and low ground preferred, because more accessible, and because here springs are more common, and wells more easily dug. Whether the soil and surroundings are fit for a residence, is a secondary consideration. When our hill-towns were first settled, the farmers built upon the mountain-sides, because the valleys were malarious. With the disappearance of the malaria, they have removed to the valleys, and are generally unaware that any other danger to health pertains to a damp location. Hence, farm-houses are often placed in the immediate vicinity of wet meadows, and scarcely elevated above the water-line; or else on the springy soil which is frequently found at the foot of a hill; or else on the "hard pan" which, at all levels, crops out here and there between strata of gravel, and which, by holding the surface-water, is always wet and cold. Farm-houses are not always located thus, by any means; but it is a mere chance if they are not. Neither can it be said that farm-

houses are more likely to be badly located than the houses in our cities and towns; but, in these latter, there is little or no choice, while, upon the farm, it is seldom impossible to select a healthful site. Farm-houses, therefore, ought to be *better* located than town residences; and it is very important that farmers should comprehend the necessity of choosing a dry and airy locality, and the dangers resulting from living on damp soil, or in a low, shut-in situation. Where the house is placed low, house-drains are sluggish and imperfect, and fogs are frequent; when shut in by higher ground, the air is stagnant, and the effluvia which naturally arise from a farm-house and its out-buildings are not blown away, and poison the systems of the inhabitants. Too many trees about a house conduce to dampness, and keep out the sunlight.

Dr. Bowditch has pointed out the influence of a damp location in inducing, or at least promoting, consumption; and the influence of the same cause, in giving rise to rheumatism, sore throat, and other inflammatory affections, is well known by all physicians.

We have sought information from our correspondents upon the subject of location, by asking two questions, the first being of a general nature, and the second relating only to the causes of consumption.

12th Question.—Do farmers or their families suffer in health from the bad location of their dwellings? If so, in what way?

The answers are as follows:—

Yes,	20
No,	24
Less than other laboring-classes,	1
Not more than other classes,	3
Total,	48

The large number of negatives, although due in part, no doubt, to the better general adaptability of the soil to building purposes in some regions than in others, is also explained in part, we are convinced, by the fact that the deleterious

influences arising from a bad location are so subtle as to be frequently overlooked by physicians, unless a special interest in the subject leads them to make it a matter of constant investigation. We therefore consider the value of the large minority of affirmative answers to be in no wise impaired by the preponderance of negatives.

A few of the negative replies are accompanied with remarks, which we will here quote: the first, it will be seen, refers to the habits of the people, and not to the location of the houses.

Burgess.—No; I explain, that they are out of doors so much of the time.

Crowell.—Not as a rule. They suffer more from living in back rooms, heated by cooking-stoves, and away from the sun. The large, *sunny* rooms are shut up most of the time.

Parks.—In exceptional instances, they may do so; not as a general rule.

S. E. Stone.—Not generally.

Taylor.—None located here badly.

Wheeler.—I am not aware that they do. A favorable location is generally selected, where cellars, barn-yards and out-buildings can be properly drained. I as often find fevers in families whose dwellings are in elevated situations, with everything clean and neat about the premises, as I do in the valleys, near streams of water and mill-dams. Bowel complaints prevail more in the valleys, but these are found more frequently in the families of mechanics than among farmers.

The following affirmative answers will be found very instructive:—

Bonney.—To some extent. They formerly planted their houses in the ground, so that timbers decayed early, and the whole structure was damp. They are more careful now; but still, they suffer from the effects of damp cellars and rooms.

F. D. Brown.—Very often; by being low, shady, and without proper drainage and sunlight.

Collins.—In a very few instances, I have known dwellings placed too near a swamp, or at the base of a mountain.

Eastman.—Yes; many of them are in damp locations, without sufficient means for proper drainage; others are in too close proximity to the barns and other out-buildings, so that they necessarily inhale the bad smells arising from them, to a greater or less extent.

Goddard.—Yes; in regard to drainage of cellars, door-yards, wells, and barns. Do not notice exposure to cold winds, etc., with one exception.

Hills.—I do not think so, except from their being set too near the ground ("planted," as it were, sometimes), which gives poor ventilation to the cellars, causes decay of sills, and other parts of the house, which might produce miasm enough to cause fevers.

Lawrence.—Yes; by being built in damp places, with the sills no higher than the top of the ground, small windows, low ceilings, and, in many cases, too many shade-trees.

Martin.—They are not careful enough about locating their houses in high and dry places.

Mercer. Only in a few cases. When they do, it is evidently caused by building their houses immediately below rising ground, or at the bottom of hills and mountains, thus making the land on which the dwelling is placed a receptacle for all the surface-water.

Paddock.—Yes, many of them do; and they are very insensible to any arguments in favor of a change of location. I have known many instances where one after another of the members of families have died of typhoid fever, evidently of local causation, and still they could not be induced to remove to a more healthy locality.

Paine.—Some of them do, where there is not proper drainage.

Pickett.—They do in some instances, from the location of houses on low ground, or near stagnant water.

Smith.—I have noticed many farm-houses where the drainage was towards the house; and in other respects I have seen bad locations.

Vermilye.—Yes. Often from the impossibility of perfect drainage; from a too great number of trees about, or too near the house; from imperfect ventilation and the absence of sunshine.

Webster.—Their dwellings are generally located in ignorance of hygienic principles, and it is a matter of chance whether healthily placed or not. They sometimes suffer from a bleak location; often from poor drainage.

Wilcox.—In the location of farm-houses in New England convenient access to the highway is the first desideratum, regardless, in many instances, of convenience to good water, beauty of surroundings or healthfulness of location, to which more regard is paid in some sections of our country. I notice much more disease in low, damp situations, especially inflammatory affections of the air-passages, and rheumatism.

It will be observed that several correspondents mention the "planting" of farm-houses too near the ground as a highly objectionable feature; also, that damp cellars, proximity to swamps and stagnant pools, bad drainage, sites at the foot of

hills, proximity of shade-trees, want of sunlight and ventilation are especially noted as causes of sickness. These are subjects which it will well repay our farmers to think about and investigate. To those whose houses have wet cellars, and damp soil about them, we commend the valuable and eminently practical paper, entitled "Drainage for Health," by the Hon. H. F. French, in the last report of the State Board of Health.

Influence of a Damp Location upon Consumption.

A separate question has been devoted to this subject, which has acquired a special interest from the well-known researches of Dr. Bowditch, who has shown that consumption is frequently caused or promoted by a wet location. The present inquiry is supplementary to his paper upon the subject in the last report of the State Board of Health, as well as to his earlier publications, and merely attempts to ascertain how far this cause is operative in the families of farmers.

13th Question. "Have you observed any instances where the location of farm-houses upon *damp soil* has appeared to induce consumption in farmers' families? If so, cite cases."

The answers to this question are, numerically, as follows :— Sixteen say "Yes"; thirty-two, "No"; and one says that he has seen it aggravated by this cause. If we add "or promoted," it is probable that the number of affirmatives would have been greater.

A few correspondents cite cases, which we will here present :—

Bonney.—A farmer's family lived in one of these low houses, and two sons of unusual vigor died of consumption, one at the age of sixteen, the other at about twenty. The mother died of the same disease, the father of paralysis. The daughters moved out of town, and, I believe, died in middle age; I cannot say whether of consumption or not.

Another family had a son and daughter die in the same manner, early. The family moved away, but are nearly all dead in early and middle life.

I attribute much of this to the dampness of the houses, which were set low, on ground not especially damp, if care had been taken in building. There are, undoubtedly, more instances of the same sort, some of which I might cite, if it were deemed necessary.

W. S. Brown.—Low, damp soil, in all cases, appears to induce consumption. I have attended a family, who might be called farmers on a small scale, in

which two daughters, successively, died of consumption, and the father of Bright's disease. The situation of the house is at the foot of a slope, although there is abundant opportunity for drainage, in one direction.

Collins.—In one instance, in a neighboring town, I think several of a family have died of consumption, by reason of the damp location of the dwelling.

Cowdrey.—Low, damp situation, doubtless, favors consumption. Example, the R—— family: eight grown up children, seven are dead with consumption, and the eighth lives almost by miracle. I think rich cream, and plenty of it, has saved his life more than once. I can remember a number of other instances, but none so marked as this. In one family, four out of six have died of consumption.

Goddard.—I have noticed one instance, where a road for two or three miles ran on a high ridge, much exposed to severe north-west winds, with soil about medium as to dampness; but this road gained considerable notoriety as the birthplace of consumption, nearly half the families losing one or more by this disease.

Lawrence.—I could cite many. In one case the home was low, many shade-trees, a river running in front, cold springs issuing from the side-hill, back of the house. The children all died of consumption before twenty. They were always better when sent from home; on returning, the cough came back. The mother also died with consumption, and, at last, the father, with rheumatic pericarditis. I could mention other remarkable cases.

Mercer.—I have seen and attended families in houses as above located, in which all the members were sickly. Some had repeated attacks of pneumonia, other members bronchitis, whilst the younger members suffered from diarrhœa, dysentery, parotitis, etc. By removing to healthier locations, I have seen their health restored, with medical treatment. I have no doubt, had they remained in these houses, but that the pneumonic patients would have died of phthisis.

Seymour.—Yes; I know of a farmer, who resides in a valley near a stream, who lost his wife, two sons and one daughter from phthisis, within five years. There was no hereditary taint, and it could only be explained by the dampness of the place where they lived.

Another, who died himself, and, in a few years, was followed by three daughters. The latter man's house was near a swamp, from which dense fogs arose nightly, except during the winter season.

In connection with these cases furnished by our correspondents, we will insert the histories of three consumptive families of Pittsfield. In the first, it will be seen that an hereditary taint existed, on the mother's side, in addition to the local influences. In the second and third no such taint was present.

1. Mr. R—— settled on a farm in Pittsfield, in 1752, and built a house near the road, on a cold, springy hill-side, where water ran into the cellar all the year round, rendering it necessary to dig a ditch along one of the walls, inside, with an opening leading out upon the hill-side below the house, whence has issued ever since (122 years) a perpetual stream of water.

Mr. R—— and his wife both lived to old age. They had six sons and three daughters who all lived to be over eighty, except one son who died at fifty-four, of typhoid fever, at the West. One of the sons remained at the homestead, and married a wife, whose father and a sister had died of consumption. She, however, as well as her husband, lived to be over eighty. They had six daughters and three sons, of whom all but one daughter and two sons have died of consumption, at ages ranging from eighteen to twenty-nine. Of the survivors, the sister and one of the brothers, aged fifty-one and fifty-nine respectively, are consumptives, and the other brother enjoys good health. He, however, had hemorrhages from the lungs, from the age of sixteen to twenty-five, when he had an attack of typhoid fever after a visit to the West, since when he has had no more lung trouble. He lived at the homestead till the age of thirty, when he removed to a dry location. He has a family who are not consumptive.

2. Mr. W—— settled on a farm not far from that just mentioned, at about the same date as Mr. R——, and built a house on wet soil. He lived to the age of eighty-five and his wife to a good old age. There was no consumptive taint in either. They had eight children, all of whom have died of consumption. Of the third generation, but six are living, and are all said to be consumptive.

In contrast with these families may be mentioned that of a farmer, who lived in the same neighborhood, on high, dry soil. He lived to be ninety, and his wife eighty. They had seven children, who are all living, in perfect health, and have reached or passed middle age.

3. In another part of the town, Col. J—— took a farm, with a house already built at the edge of a wet meadow, on ground not elevated more than a foot or two above its surface. He had an iron constitution and lived to old age, as did also his wife. They had three children, of whom one, a son, died of consumption. Two daughters are living, in poor health, with consumptive tendencies.

Most of the farm-houses in this neighborhood are built on dry, gravelly soil, and the families occupying them enjoy remarkable health, and are entirely free from consumption.

Information of a more general nature, upon this subject, is furnished in the following answers from our correspondents :—

F. D. Brown.—No. I have, however, seen cases of consumption very much aggravated in certain locations; but I am not prepared to say the disease was induced by it.

Crowell.—Yes; in a soil with clay deposit, with no drainage from cellars. Many farm-houses have damp cellars three months of the year, and the peculiar odor is quite apparent upon entering the house.

Dickson.—Have seen cases where the fog rising from a swamp caused dampness, thereby causing consumption. We have a sandy subsoil, which does not hold water sufficiently to cause dampness.

Eastman.—I think I have, in several instances, but cannot now recall them, so as to give particulars.

Eddy.—No. Farms in this section are well placed for drainage, and consumption is not of frequent occurrence among our farming-class. With the operatives in mills, the case is different.

Haddock.—No; we have very little soil of this kind under cultivation.

Hawkes.—I am convinced, from long experience and close observation, that very many of the chronic diseases that we have come from the bad location of houses. I should not confine the bad effects to the production of consumption merely.

Hills.—Farmers' houses are usually set upon high ground; *i. e.*, high enough for the cellars to be dry, though they are frequently surrounded by wet lands. I have not thought that consumption was induced by damp soil (among farmers) so much as by the occupation of working in palm-leaf. In braiding, the fingers are wet much of the time, which makes *cold hands, and also cold feet*, which would tend to produce congestions internally, especially of the lungs. I once knew a very severe case of lung fever which I thought was caused by paring *frozen apples*. The patient lived, but never has had robust health since. I think houses are more apt to be located on damp soil, in and near crowded villages, where there are water-power manufactories.

Morse.—Farm-houses are generally situated upon a hill, or swell of land.

Parks.—I have, in several cases, observed pulmonary consumption on elevated places where the impervious subsoil produced dampness near the house. I believe damp soil to be favorable to the development of consumption; yet, in the cases that have passed under my observation, there may have been some hereditary pre-disposition to the disease.

Phillips.—Yes; two cases only.

Reynolds.—I have noticed several tenement-houses where the tenants often changed,—sometimes twice yearly; and every new family was sure to be attacked with some acute disease. These could not be called strictly farm-houses, but were generally occupied by farm-laborers.

Wheeler.—I cannot recollect any particular instances. Farm-houses, in this vicinity, are rarely located upon damp soil,—or, if the soil is damp, proper attention is given to drainage. Consumption is rare in farmers' families.

Wilcox.—I practised for some time in an elevated region, almost free from consumption. Here, it is rather low, and this disease is quite prevalent. I cannot, however, instance any cases which I am satisfied resulted from the special dampness of any particular spot.

One correspondent sends us a case in which consumption was *not* induced by a damp location.

Burgess.—Mr. J—— B—— at seventy is strong and well. He was born and has always lived in a house, the cellar of which is afloat very much of

the time,—whenever Charles River is at the high. His wife, also well, has lived there with him, since she was young. His father, a well man, lived there before him to be over eighty years of age. Their two children are not very healthy. There is no rheumatism about the family.

Cleanliness of Surroundings.

The active influence of local uncleanliness in producing certain forms of sickness is too well known to demand any explanation here. Much evidence on the subject may be found in all the previous reports of the State Board of Health, and especially in an article by Dr. Derby, on "The Causes of Typhoid Fever," in the report for 1871. This disease and the summer bowel disorders abound in the vicinity of putrescent animal and vegetable matters, which exert a morbid influence upon the human system in two ways, viz., by poisoning, first, the air; second, the water. About farm-houses, we are sure that such causes of sickness are much less frequent than about the tenements of the very poor; yet, that they do exist, we know from personal observation, both of their nature and results. It will be seen, however, that this fact carries with it no special disgrace, when we add that there is no dwelling in the State, of any class, which possesses an absolute immunity from these causes; for they are often so hidden and subtle as to elude the search, not only of the intelligent landlord, but also of the most vigilant health-officer.

The most frequent sources of pollution of the air or water in or about farm-houses, are faulty drains, neglected privies, foul cellars and barn-yards. Of these, the first two are the most dangerous, from being the most poisonous, the most frequently existing, and also conveniently placed to infect the house. Cellars are less often unclean; and the decaying vegetables which they contain are less noxious than the contents of drains and privies. A foul cellar, however, readily contaminates the air of the whole house. Barn-yards are doubtless the least active of these causes, partly because they are not often very near the house, and partly because the manure of herbivorous animals produces a less poisonous effluvium than either the privy or sink-drain. Its worst feature is the hogpen, whose stench is no less deadly than theirs; and the cow-yard itself, if allowed to contain a stag-

nant pool, which becomes the receptacle of all manner of refuse, may become equally pestilential. All of these causes we have observed as undoubtedly producing, or, at least, promoting typhoid fever.

Our correspondents have favored us with valuable information upon this subject, in their answers to four questions, relating respectively to drains and privies, to cellars, to barn-yards and to drinking-water.

14th Question. (1) "Are farm-houses apt to have imperfect drains or neglected privies; and (2) have you observed cases of fever or bowel disorder dependent upon such causes?"

The answers are as follows :—

	To first part of question.	To second part.
Yes, ...	40	34
No, ...	9	15
	49	49

The following are some of the most instructive answers :—

Bonney.—They are. I have. Last year, I had a family of Canadian French people, living in a low-planted house, with a pool of sink-water at the back-door, and garbage strewed about, in which the mother and every child, five in number, had typhoid fever, one of the children dying of hemorrhage of the mucous surfaces generally. I gave the Board of Health a statement, some years since, of a family in which nine persons were apparently affected from the stench of the *debris* of a slaughter-house, spread upon the land in their vicinity. Years ago, when the barn-yards had standing water in them the year round, *fever* was rampant.

F. D. Brown.—Yes; I have seen cases of typhoid, which I could trace to imperfect drains, privies, pigpens, etc.

Cowdrey.—They have been, but, thanks to the labors of the health officers, a better day is dawning in regard to sink-drains. The fertilizer question now saves the privies.

Crowell.—Privies generally without vaults, and often the cause of typical dysentery. The odor from these privies and drains, in hot weather, is often very offensive.

Eastman.—Yes. I have observed several cases of fever, while acting as inspector on board of health, which I thought were directly traceable to these causes; some very well marked ones of typhoid this season, which, with *no*

change in medical treatment, began to improve at once after a thorough renovation in a sanitary way, and were soon convalescent. In fact, the change was so marked that it was noticed by all in the neighborhood, and the board of health was in greater demand than ever.

Eddy.—Yes. Cases of fever and bowel disorder, dependent upon these causes, are very numerous all about us.

Goddard.—Think I have, where nearly the whole of large families have suffered, with several fatal cases.

Haddock.—Yes; I have seen typhoid result from these causes. I frequently speak about these evils, I am sorry to say, with poor results.

Hartwell.—Have noticed several instances of imperfect drains, especially sink-drains producing typhoid fever, and, in two instances, of a contagious character. I think drainage generally imperfect, though in newly-built houses this is remedied to a great extent.

Hills.—Occasionally cases occur where the cause can be attributed to such conditions; but oftentimes it seems well-nigh impossible to trace their occurrence to any such cause, the building and grounds being unexceptional in condition and location.

Hitchcock.—Yes. I think I can recall several cases in farmers' families, where, during the prevalence of epidemic typhoid, or dysenteric, or scarlet fever, greater malignancy was manifested in houses that were very old, and whose drainage and privies were in a filthy condition.

Lawrence.—As a *general* thing, they have neglected drains, or no drains at all; their privies emit the king of stinks. I have seen whole families sick with diarrhœa and dysentery, and also fevers, from this neglect.

Mercer.—The majority of the houses are well drained. I have had one case of typhoid fever this year, caused by an obstructed drain from the kitchen of a farm-house.

Paddock.—Yes. I have known of quite a number of instances where dysentery, cholera-morbus and typhoid fever have undoubtedly been caused either by filthy privies, the barn-yard draining into the well, or decaying vegetables in the cellar or near the windows of farmers' houses.

Parks.—I think, as a class, farmers are negligent in this particular. I have often met with fevers and cases of bowel disorder that I referred to this cause.

Pickett.—Yes; especially privies, both near farm-houses and school-houses. Some of them, having deep vaults, remain for years a source of annoyance, producing diarrhœa and dysentery, contaminating, not only the atmosphere, but the water in the wells. One farmer removed his well from the kitchen some thirty feet distant, supposing he should get pure water, but without success, for both hogpen and privy were located between the well and the highland from whence deep springs fed the well.

L. R. Stone.—As to the first part of the question, I can say, from a limited acquaintance, very imperfect drains, if any at all, and privies a disgrace to civilization.

S. E. Stone.—Such drains are generally open to the air, and often offensive, the privies almost always so. The simple means of dry-earth disinfection seems to be ignored, if not unknown. I have seen several wells which were polluted from sink-drains, or privies, or both, to such an extent as to render the water offensive to drink, but generally this has not produced severe trouble, though I believe it has often been one of the factors of disease.

Wilcox.—Few farm-houses have even a vault under the privy. Excrementitious matter is frequently allowed to accumulate until the quantity is so great as to necessitate its removal; and a large proportion of farm-houses have no drains, slops being thrown out of the back-kitchen windows or door, upon the ground. I have seen some cases of fever and bowel disease, which, I am satisfied, resulted from this disobedience of sanitary laws.

Winsor.—Not in my own practice; but from what some of my professional neighbors have told me, I am confident that such is not infrequently the case. Women and children often suffer in inclement weather, in the country, from having the privy so emphatically an "out-house."

These replies show that farmers share with other people the penalties attending imperfect drains and defective privies. Now, this is an evil which ought not to exist. It is sometimes excusable in the crowded tenements of the town or city, and among people too ignorant to know its dangers; but on the farm, where there is abundant space, where it is easy not only to dispose of but to utilize filth, and especially among our intelligent Massachusetts farmers, we ought to find these sources of disease most exceptionally rare. The object to be gained is of the utmost importance, and the means of attaining it exceedingly simple. No farm-house should be without a commodious covered cesspool, several rods from the house, on lower ground, if possible, and connected with the kitchen sink by a well-constructed *covered* drain. In default of a brick cesspool, an inverted hogshead will do, if the soil be porous, but a barrel, never; it is too small to be of any use. The drain should then be kept free, so that the cesspool can be so *used*, that not a drop of dish-water, slops or any kitchen refuse whatever shall find its way out upon the surface of the ground, from the back door or window. Everything should go into the cesspool, except what the pigs can consume, and the back of the house should rival the front in cleanliness and tidiness. Our farmers should never forget that an open, stagnant drain under the kitchen window is an enemy to their households, as much to be dreaded as were the Indians by the first

settlers of the colony, for it is even more stealthy and murderous than they.

As to country privies, one of our correspondents has well said that they are "a disgrace to civilization." A philosophic friend of the State Board says that "the march of civilization is in no way more correctly marked than by perfection in water-closets." If to this rule a universal application were given, it would place our farmers, as well as the vast majority of our rural population, well back in the ranks of barbarism. We prefer to believe that this is the only respect in which they are behindhand; but that they are so in this, is very certain. The common country privy, unventilated, except by the door, standing over a reeking mass of corruption, either contained in a vault or lying upon the surface of the ground, a place foul and pestilential beyond description,—this must be the daily resort of every member of the farmer's family. If it adjoins the house, its poisonous odors penetrate to the living-rooms; if standing several rods away, as it frequently does, an exposure to the weather is involved in reaching it. In either case, in winter it is frightfully cold, and its use involves a chill, which, to women and children especially, coming from the warm rooms, is a potent cause of disease. Undoubtedly, the constipation which is so general among country women, is, in great part, due to the dread of going to this abominable place.

What is the remedy for this evil, since water-closets are next to impossible, in the country? It is this: in summer, the common privy may be made inodorous and safe by having a proper vault, with a ventilator, and by thorough disinfection. This is accomplished by throwing into it daily a quantity of dry earth or coal-ashes, a shovelful of lime or a couple of handfuls of copperas. It is made most thorough by the combined use of dried earth and copperas, experiment having shown the last to be the best chemical disinfectant for privies. As it can be bought for from two to five cents a pound, an abundant supply of it should be kept constantly ready for use. When the privy is *perfectly* inodorous, disinfection may be considered complete; but not otherwise, It is hardly necessary to suggest to farmers the emptying of vaults, annually or oftener, since this is required by the necessity for fertil-

izers. In winter, and all bad weather, the privy should be supplanted by the earth-closet, which should be placed in a room not uncomfortably cold. This is a convenience, which, in the farm-house, finds its most perfect adaptation; for here the obstacles to its use in cities, viz., the difficulty of keeping up the supply of dry earth and of removing the waste, are inoperative. On the farm, dry earth is abundant (altogether *too* abundant in seasons of drought), and there is always shed-room in which to keep a bin of it from the weather. As for the refuse, it is invaluable for the compost-heap. If every farm-house possessed an earth-closet, many diseases resulting from blood-poisoning, exposure and constipation would be greatly diminished in frequency.

Decaying Vegetables in Cellars.

That this is among the causes of sickness in farm-houses, the following correspondence shows.

15th Question. "Have you seen sickness produced by decaying vegetables in the cellars of farm-houses?"

To this, 23 correspondents reply "Yes"; 24 "No"; and two make no answer. About half of them, therefore, have observed this cause and its deleterious effects.

Among the affirmative answers occur the following:—

Crowell.—Yes; often. A great neglect exists in this particular. The odor from this cause is very marked in the early spring, on entering the house.

Eastman.—I have found cases where that was the apparent reason, and in which there was great improvement upon removing all such refuse, and thoroughly disinfecting the places in which they were kept.

Goddard.—Think I have. For instance, the case of a farmer of means, his wife and five children. Four sickened in September of typhoid fever, and three died. In the cellar were found half-decayed cabbages and other vegetables, half a barrel of old fish-brine, and filth generally, so that the smell was noticeable, rods from the house, when cleared out by the doctor's direction. Have seen other similar cases.

Haskell.—In a house occupied in part by a farmer, typhoid fever was occasioned in two families, in the other end, by vegetables placed in the cellar immediately beneath them by him.

Hitchcock.—I have; typhoid fever and dysentery.

Lawrence.—Yes. Only last spring I had a case of chills and fever, where there was water and decaying vegetables in the cellar, which was not ventilated.

Miller.—Have seen some cases of diphtheria, which I judged were caused by such things, combined with extreme dampness of cellar and a prevailing damp and chilly atmosphere.

Phillips.—I have not only seen fevers caused by decaying vegetables, but also from rotten timbers, boards and other rubbish lying on the bottom of damp cellars.

Vermilye.—Yes; chronic diarrhœa by decaying cabbages and carrots. The disease, of several weeks' standing, was at once arrested by the discovery of the supposed cause and its removal.

Proximity to Barn-yards.

16th Question. "Is sickness apt to be produced by the house being too near the barn-yard?"

To this question, 23 reply "Yes"; 23 "No"; and three make no answer.

Of the affirmative answers, the three following are examples:—

Bonney.—Yes; especially where water is allowed to accumulate, and absorbants are not used freely. I consider this to be one of the most prolific sources of disease in the country.

Smith.—Yes; if the relative position of the house and barn-yard is such that the drainage is toward the house.

S. E. Stone.—I think not generally, though I remember an instance where the pigsty was the cause of a severe dysenteric attack to every member of a family of four persons. It was situated close to the back-door, and was in a terribly filthy condition, and the stench pervaded the living-room when the wind was from that quarter. After covering this with fresh, dry earth, and turning the water away, the family made a rapid recovery.

The negative side of this question is represented by the three answers that follow:—

Burgess.—I incline to the belief that those awful stinks must be healthy, *somehow.*

Hitchcock.—Have no knowledge of such cases. The excrement from the ox or the horse I do not believe so noxious as that from the hen, the hog or human beings; the last, I believe, is terribly noxious, and God's wisdom and benevolence were especially manifested by his servant Moses, in commanding the children of Israel to carry sticks with them, on their journeyings, to dig holes in the ground to bury their "dung."

Taylor.—No. Have known cases where a "life in the barn" has acted beneficially, adding pound upon pound to the weight of the individual.

Drinking-water.

The instrumentality of drinking-water, and especially of well-water, in the production of fevers and bowel disorders is a fact constantly observed. Surface-water finds its way into wells, carrying with it a portion of the impurities which may lie upon the ground, and thus, in time, renders the water foul. This fouling is a slow process, since the ground acts as a filter, and removes the largest share of the impurities before the water reaches the well. It is a sure process, however, and one, to guard against which, no pains should be spared to keep the surface in the vicinity of the well free from all decomposing substances. Dr. Derby states* that, as a rule, a well receives drainage from a superficial circular area, whose diameter is from one to three times the depth of the well, varying with the character of the soil. To keep the latter area in a thoroughly purified condition is, therefore, a good and safe rule to follow. This is doubtless done, in many cases, but the cases where it is not are extremely numerous. By this rule, a well twenty feet deep should have no privy, pigpen, barn-yard or drain, or have slops or garbage thrown upon the surface within thirty feet of it, in any direction. We think there are but few farm-houses where this rule is not utterly disregarded; and, as a consequence, although new wells are not affected, most of the old wells are foul, and the water liable to produce sickness. Beside the leachings, wells, from not being properly covered, become the receptacles for all sorts of decaying rubbish from the surface, such as leaves, rotten wood, dead rats, toads, etc. The greatest danger from all these impurities is when the water is so low that the splash of the bucket stirs up the sediment, or when a copious rain causes a sudden rise in a very low well, accompanied with a thorough stirring up from the bottom.

The present inquiry is concerned only with farmers' wells, and the question whether they are, as a rule, as pure as they should be. That many farm-houses have water of surpassing purity, whether drawn with "the old oaken bucket" or a good modern pump, there is no denying; but that many others

* First Report State Board of Health.

are strikingly defective is equally certain. We have seen, for instance, a well dug at the edge of the barn-yard, so as to supply both the stock and the family; another *in* a particularly filthy barn-yard, and the water used for drinking purposes, when not *too* offensive; a third close to a back-door, with slops habitually thrown out close to it, so that, if they did not actually trickle down the well itself, they speedily found their way in through the soil. In the families drinking the water from these wells, occurred fatal cases of typhoid fever.

Our correspondents supply considerable testimony on the subject; and several of them also bear witness to the fact that farmers suffer from the use of water drawn through lead-pipes.

17th Question. "Are farm-houses apt to be supplied with impure water? If so, with what result?"

To this, we have 21 affirmative replies, and 24 negatives, four making no answer. As results, nearly all mention fevers and bowel disorders, while six also mention lead-poisoning. Of those replying in the negative, many speak of the general excellence of farmers' wells, and the purity of the water. As our aim is to warn, rather than to congratulate, we will make a selection from the affirmative answers only.

L. S. Adams.—Well-water is the most common. Liable to become impure from drainage, resulting in fever.

Bonney.—I think they are, although there is improvement in this particular. The sink-water is apt to penetrate to the well, decaying leaves and wood are apt to be allowed to enter the water, and there is great carelessness in the use of lead-pipe. The occasional result is colic; but, from other causes, bowel troubles, loss of appetite, etc.

Collins.—Wells frequently become impure, and fevers are the result.

Dickson.—Yes. The water is mostly taken from wells, which are apt to be neglected, causing bowel disorders.

Eastman.—As a class, I think they are; that it is productive of fevers.

Goddard.—Frequently; and have seen bad cases of typhoid fever apparently due to this, among other causes. In one family where fever prevailed, slops were put upon the ground, nine or ten feet from the well, and the water was offensive to taste and smell.

Lawrence.—They are, the wells not being often cleaned out, while a great many use water which runs through lead-pipes. I have known well-water to be rendered unfit for use by the too close proximity of the barn-yard.

Martin.—Yes; too near privy; also by lead.

Miller.—Have seen typhoid fever in three families, which I felt sure arose from such cause.

Paddock.—I have known of cases of dysentery and kindred diseases apparently from contamination of the water in the well, by the drainage from the barn-yard.

Sleeping Apartments.

In relation to farmers' bedrooms, it is a frequently observed fact that they are of insufficient size and poorly ventilated, and are often on the ground floor, opening from the kitchen. Farmers are also apt to sleep upon feather-beds, in preference to hair-mattresses. Desiring to ascertain whether these facts have been observed by our correspondents, and also whether, if observed, they are found to be prejudicial to health, we have included the following in our list of questions:—

18th Question. "Are farmers or their families apt to be injured in health by sleeping in small, badly-ventilated rooms, or upon feather-beds?"

To those circulars last sent out was added, "on the ground floor."

To this question, 34 correspondents say "Yes"; 13, "No"; and 12 make no answer.

The most valuable and extended information that we have received upon this subject is from a very accomplished lady, whose habits of observation and thought are such as to constitute her an authority upon this, as well as many other topics. In response to our request for information, she has kindly prepared a paper, entitled "Some Farm-houses, and Some Mistaken Ways of Living in Them," which is appended to this article. It treats, not only of bedrooms, but of everything pertaining to the farm-house,—site, construction, drainage, etc. For its practical value, its remarkable good sense, its accuracy, as well as for its most agreeable way of presenting all subjects of discussion, we commend it to our readers.

From the letters of our medical correspondents, the following are selections :—

Beane.—Yes; feather-beds, except in *cold* weather. The custom of children sleeping in the garret, always poorly ventilated, is especially pernicious.

Bonney.—They are. They learn the lesson of ventilation slowly. With regard to feather-beds, they are apt to become damp and sour from perspiration, especially in cases where children sleep with their parents. The occupants sleep too warm, and get cold and are debilitated, in consequence.

F. D. Brown.—Yes; and in my opinion, no class is more careless in this particular than they.

W. S. Brown.—Yes; very much so. Ventilation is almost unknown, so far as I have seen.

Crowell.—Yes; most farmers sleep on feathers, and often in small, badly-lighted bedrooms. Many large houses have sleeping-dens, called "dark bedrooms," and these on the ground floor.

Lawrence.—As a general thing, they sleep in the poorest rooms in their houses, which are very small and poorly ventilated. Feathers are an abomination.

Paddock.—I think they are, especially by sleeping in small, poorly-ventilated rooms.

Smith.—I do not know why *they* should be less apt to be injured than others. I think that they do sleep in small and badly-ventilated rooms, and are, in consequence, injured. The sleeping-rooms are much too small and badly ventilated, because farmers are not properly taught in the matter of fresh air during sleep.

Taylor.—Yes; by all. The best room in all farm-houses has its feather-bed.

Vermilye.—I think one of the most frequent causes of disease is bad ventilation,—the sitting and sleeping in rooms in which the air has been burned by up stoves, or otherwise vitiated. The prejudice against fresh air is a common one, perhaps not shared in by farmers more than by any other class of the community.

Wilcox.—They are, from sleeping in small, badly-ventilated rooms, though the tenement-houses here are worse than the farm-houses, in these respects.

There is much which might be added in relation to farmers' bedrooms, but it is so much better expressed than we could do it in the appended paper to which we have just referred, that we refrain from adding a single word, except that we fully indorse all that is there stated.

Mental Influences.

In order to ascertain to what extent our farmers suffer *mentally* from the nature of their occupation, with its labors, cares and anxieties, we have endeavored to prepare some statistics concerning the amount of insanity among the farmers of the State. To this end we have compared the reports for 1873 of the State Lunatic Hospitals at Northampton, Worcester and Taunton, and the McLean Ayslum for the Insane at Somerville, adding thereto some information received concerning the Essex County Insane Receptacle, at Ipswich.*

At the Northampton Hospital, of 97 male admissions during the year, 12 were farmers, 12.37 per cent. Of 572 male admissions during twelve years, 126 were farmers, or 22.02 per cent.

At the Worcester Hospital, of 251 male admissions during the year, 16 were farmers, or 6.37 per cent.

At the Taunton Hospital, of 2,501 male admissions, during nineteen years, 289 were farmers, or 11.55 per cent. The number of patients, by occupation, for the past year, is not stated, but the same percentage of the 260 admissions during the year would give 30 farmers.

The report of the McLean Asylum has no table of occupations; but we are indebted to the superintendent, Dr. Geo. F. Jelly, for the statement that, of the 121 male patients treated in the hospital, during the past year, 10 were farmers, being 8.26 per cent.

The superintendent of the Essex County Insane Receptacle at Ipswich, kindly informs us that, of the 50 male inmates the past year, 13 were farmers, or 26 per cent.

Taking the five hospitals together, we have a general ratio of farmers of 10.39 per cent.

The same computation applied to business men shows that

* We are sorry not to have been able to make this comparison more complete by including the insane at Tewksbury and South Boston. The Superintendent of the State Almshouse at the former place, writes that the insane under his charge are "harmless incurables" from other hospitals, mostly foreign laborers, and there are no means of learning their occupation. From South Boston, we have been unable to obtain any information

they stand to the whole number of patients in the ratio of 14.54 per cent.*

Comparing the number of insane farmers with the whole number of farmers in the State (including agricultural laborers), it appears that there is one to 873; while, of insane business men, there is one to 480.

The sources of error, however, in this calculation are so many, that the result can be nothing but the merest approximation. In the first place, the five hospitals mentioned contained, in October, 1873, but 1,435 inmates, while the United States census for 1870, shows that there were then 2,662 insane persons in the State. Again, it is uncertain to what extent agricultural laborers were classed as farmers. That they were so at Northampton is stated in the report, but the others make no reference to the subject.

Of the whole male population of the State, over ten years, 13.12 per cent. are farmers. The number of insane farmers to the whole number of insane is therefore less than the proportion of farmers to the whole population.

Referring to the large proportion of farmers at the Northampton Hospital, Dr. Earle says, in his report:—"In the 126 farmers are included, not proprietors or land-owners alone, but the mere laboring agriculturists, as well. The number under this head is the largest, and aside from that under the comprehensive term 'laborers,' by far the largest of any in the table. Let no one hastily infer that, of all classes, farmers are the most subject to mental disorders. Nothing could be more erroneous. In the four counties from which the hospital chiefly derives its inmates, agriculturists are overwhelmingly more numerous than any other section of the population, as classed by occupation. So far as mere employment is concerned, as a generative cause of insanity, the farmer is unquestionably less liable to that disorder than perhaps any other person. He is in a sphere more nearly natural than the artisans, the mechanics and the professional men of a civilization abounding with artificial conditions and influences."

In order to obtain further medical opinions regarding the

* This is based only on the four first-named hospitals. If that at South Boston were included, the percentage would probably be larger.

prevalence of insanity among this class, the following question has been sent to our correspondents :—

19th Question. "Are farmers specially liable to become insane? If so, from what causes?"

Answers: "Yes," 4; "No," 38; no answer, 6; almost an unanimous negative.

But few have made any answer to the questions, beyond the mere "yes" and "no." A small number, however, have sent more extended answers. On the affirmative side, we have the two following :—

Hitchcock.—I think they are. More suicides among farmers have been observed in my practice for the last thirty-seven years than among all other occupations. Indifferent success, *ennui,* distaste for the occupation, sometimes intemperance, and perhaps envy and jealousy of the greater success of neighbors or relatives in other occupations.

Phillips.—Yes; from excessive and continual labor, and want of sleep, in consequence of losses and anxiety about the farm.

On the negative side we have the following answers :—

Haskell.—No. You must look for such cases among the more isolated and lonely farm-houses in the country.

Hawkes.—I have never known an insane farmer, unless it was from alcoholic drinks or some other cause outside of farming operations. There are cases of what are called "sunstrokes," producing insanity, but they are not peculiar to farmers; yet I think they are more exposed.

Hills.—I do not know that they are specially liable; cases occur, but perhaps not more frequently than among other classes of people. Causes: worry about work or money, grief, long and tedious illness causing debility of nervous as well as physical system. After long-continued work in severe cold weather, I have seen insanity occur.

Paddock.—I am not prepared to say that they are. I think that they are apt to become moody, melancholy and despondent, from their isolation and consequent want of social intercourse, and hard work continued month after month and year after year, from daylight until dark.

Wheeler.—Do not recollect that I have ever seen a case of insanity in a farmer, except in one instance in which the disease was hereditary; and in this it was induced more by political excitement than by agricultural labor.

The evidence upon this subject shows quite conclusively that farmers are not specially liable to insanity. We believe that a contrary conclusion has been reached by some recent writer; but are unable to refer to the article.

But that causes of insanity are not altogether wanting, is shown by the eighty-one farmers admitted to asylums the past year. What these causes are, have been indicated by our correspondents. The chief causes are probably unremitting labor and anxiety. Dr. Earle truly says, that the farmer lives "in a sphere more nearly natural than the artisan, mechanic and business man," and yet his occupation, while allowing him an abundance of fresh air and active exercise, a variety of duties, and freedom from intellectual strain, is too often unnatural, in that he labors too incessantly and joylessly, and worries and frets about his crops, his stock and his mortgage. This sort of life is more productive of insanity than profound study, for the latter, if rationally pursued, is more apt to strengthen than exhaust the mind. The tendency to overwork and to be overanxious are, in their excessive development, striking American traits, and do not belong to our farmers alone. The remedy which farmers need, as well as many other people, is *more recreation.* This remedy is to be applied, not by the legal establishment of more holidays, but by showing the people the necessity of unbending more frequently, so that they may make recreation a science, and take a holiday and use it to the best advantage when warned to do so by physical and mental weariness. Recreation is essential to the physical, as well as mental well-being; and, while one cannot too strongly deprecate the vice of idleness, we also deprecate the dread of having a good time, and of being young again occasionally, which is so prevalent among the steady portion of our adult population.

To obtain still further information upon this subject, the following question, the last of the series, has been sent to our correspondents:—

20th Question. "Do farmers suffer from want of recreation?"

Answers: "Yes," 25; "No," 21; no answer, 3.

The replies are full of value and interest. Upon the affirmative side, we quote the following opinions:—

Bonney.—They do greatly. There is work to be done, in the way of "chores," when they attempt it, so that recreation of a complete character is difficult of attainment. There is, however, improvement. The multiplication of agricultural fairs, horse-trots and various exhibitions, farmers' clubs, etc., call the farmers more from home, and they get, not only physical change and rest, but also mental stimulus, which is beneficial to them in the way of health. In fact, the higher the position upon which the farmer can be placed, intellectually, the healthier he will be, in my opinion. The causes will be obvious.

F. D. Brown.—Yes; more than most other people. As a class, they are inclined to follow in the tracks of the "fathers," and regard all changes as innovations of their rights.

W. S. Brown.—Yes; the great bulk of them *vegetate.* Farmers' clubs, in such towns as Concord, Massachusetts, help to mend matters.

Haddock.—Yes; they do. I doubt if they do more than other men. They think they cannot afford the time or money; and they don't know how to recreate, when they attempt it.

Hills.—Yes; I think they do, some portions of the year; and at others they have a surfeit. If there were more recreation in those seasons of the year where we now have overwork, I think there would be less insanity, and less of nervous debility; less dyspepsia, and less of all diseases that are caused by loss of vitality or reserved nervous force.

Hitchcock.—I think they do, especially in the long winter season.

Lawrence.—Yes; I have no doubt of this. Their winter evenings are, in many cases, long and dreary, although shortened by reading papers and magazines. Still, their lives are too monotonous. More gala-days would do them good.

Paddock.—Yes. I think farmers do suffer from want of recreation; but more in their dispositions and good-nature than in health. What they most suffer from is want of rest. The farmer always has something that needs to be done at once; if it is neglected, he knows but too well that his pocket will suffer. He usually employs too little assistance, and is therefore kept constantly employed. Sowing, cultivating crops and harvesting have to be done, rain or shine, in season, if he expects a return for his time and labor. The seasons do not wait. In winter, his stock must be cared for, whether he is sick or well.

Smith.—No more than other classes. In my observation, they usually attend circuses and shows, etc.; but they probably, with all other classes, as society is at present constituted, are suffering from a want of "recreation," in not knowing what recreation is, nor why it should be pursued, nor the method of attaining it. The question how the farmer can best be recreated is one of serious moment, and deserves a proper answer.

S. E. Stone.—I think they do, as a general thing. They do not allow them-

selves a proper vacation, nor cultivate the social element of life sufficiently. These, together with the want of intercourse almost necessary to their occu pation, frequently produce a stunted mental growth, if not a positive atrophy of the higher faculties.

Taylor.—Farmers generally have little or no recreation. Assuming that recreation is necessary to long life and health, farmers, in consequence, must suffer. This is true, also, of many other classes.

Winsor.—Yes. I believe they would have less dyspepsia and headache, if they laughed and played more, and led less monotonous lives.

Wilcox.—Their wives and daughters need more recreation.

Upon the negative side, there is a less full expression of views; but those which are expressed are very full of interest, as will be seen by the following:—

L. S. Adams.—Only in the temper and habit of their minds. *Easy* labor, from habit, becomes recreation.

Burgess.—A farmer's daily life is a constant recreation. Three consecutive days are very seldom spent about the same thing.

Goddard.—No. Think the farmers here spend more time in recreation than the people generally. Having teams, they ride, and their families also, more than others, while social neighborhood chats are much more frequent than with mechanics. Most of our farmers are far from villages, railway-stations, etc.

Haskell.—No. There is much social intercourse among our farmers and their families; they enjoy a variety of land and ocean scenery, meet with many strangers, are independent, finding a ready sale for their products, and are, altogether, as thriving a class of people as can be found.

Hawkes.—I think not necessarily. Farmers are the most independent class of men that we have among us. They live "under and about their own vines and fig-trees, without any to molest or to make them afraid"; have their recreation days and feasting seasons; build themselves fair-grounds and parks, and luxuriate in all the bounties and beauties that nature so richly provides.

Wheeler.—No. The gambols of their young stock, the beauty of their fat horses, and oxen, and milch cows, and pigs, and poultry, their annual fairs, and, indeed, their very employment, afford them more satisfactory recreation than the professional man, the merchant, the banker, the mechanic, etc., can derive from the theatre, the opera or any other source.

Recapitulation.

The conclusions to be derived from the preceding investigations may be summed up briefly as follows:—

The farmers of Massachusetts are, as a class, fully as prosperous as those of the great agricultural States of the Union.

As regards longevity, they are second to no other class of the community.

Farmers' wives are not as long-lived as their husbands.

In point of general health, farmers compare favorably with other classes.

Intemperance is rare among them.

The chief causes of sickness to which they are subjected are these :—

1st. Overwork and exposure, the women being more frequently overworked than the men.

2d. Improper and improperly-cooked food.

3d. Damp location of dwellings.

4th. Want of cleanliness about their houses, especially in reference to drains, privies, cellars and proximity to barn-yards and hogpens.

5th. Impure drinking-water, largely due to the preceding cause.

6th. Bedrooms imperfectly ventilated and on the ground floor; with the too general use of feather-beds.

7th. Insufficient recreation.

Thus it appears that our agricultural class, although deriving health and vigor from the nature of their occupation, are yet frequently injured in health, and their lives are shortened, by *preventible* causes. To allow these causes to remain in operation, after they are known to be preventible, cannot, in the present advanced state of sanitary science, be regarded otherwise than as a crime. But wilful neglect is less common than ignorance, and therefore a reform will be more easily brought about by instruction than by legal enactments. For a State to take official measures, as ours has done, to instruct its citizens in the art of prolonging life and promoting health, is one of the most beneficent applications of legislation, and directly conduces to the material prosperity of the State. It is safe to predict that, when our people are thoroughly instructed in sanitary laws, when they have learned to so economize labor as to have a little more time to think of themselves, and when they apply more of science to their daily life, there will be no finer class of people in the world than the farmers of Massachusetts.

SOME FARM-HOUSES AND SOME MISTAKEN WAYS OF LIVING IN THEM.

By Mrs. THOMAS F. PLUNKETT, Pittsfield, Mass.

In calling attention to the gross sanitary defects in some farm-houses, and certain injurious habits of living, it must be remembered, that many of these houses are not newly built, that the owners have inherited them from fathers who lived relatively in the "dark ages." A half century ago, physicians themselves were ignorant of some of the now familiar laws of life, which have been stated and re-stated in the ears of the present generation, so often and so fully, that they have come to be regarded as a part of that commonplace and traditional fund of knowledge which we daily and hourly use and act upon, without ever thinking how, or when, or where we came by it.

It will be difficult to make a true sketch of some of these abodes and ways of life, without being thought a caricaturist by people who live in our comfortable, well-drained, gas-lighted towns. Thousands of these never passed an hour in a house so poorly located, and planned, and built, and furnished and cared-for (taking "poorly" in a strictly sanitary sense), as hundreds that to-day exist in Massachusetts. The family physician alone, of all educated persons, will recognize the lineaments, and his locality may be rated fortunate if it does not furnish more than one likely "original."

Fifty years ago, sanitary engineering was an undiscovered art, and drainage, as at present understood, not thought of; having no place among the considerations which governed the selection of the site of the future house and home.

The leading ideas, generally, were nearness to adequate supply of water, and "handiness;" handy, meaning convenient. These prime requisites were sometimes modified by the supposed protection from cold, furnished by some hill, which looked like a bulwark against the prevailing winds of the section.

Occasionally the choice was decided by the picturesque neighborhood of some ready-grown sheltering tree, but this was rare, practical considerations generally holding the casting vote. Too often, the fascinating tree was a huge, indigenous willow, which ought, in itself, to have furnished a complete condemnation of the spot as too wet for a house. Where willows grow *spontaneously*, the soil is so damp that the exhalations constitute a perpetual cold vapor-bath,—how cold, let those testify who have driven over some springy, ozier-bordered stretch of road, at nightfall.

The farmer's definition of "convenience," analyzed, means, proximity to the barns and outbuildings; these having been wisely placed with reference to water-supply. Too often, the placing of the *house* was only secondary to, and dependent upon, that of the barn, an order of precedence never to be commended, and which will surely disappear under the light of advancing intelligence. In nine cases out of ten, the house was too near the barn for sanitary safety.

The greatest inconvenience which could come from placing the barns so far off that their deleterious and offensive odors could never reach the house, would be felt after a heavy snow-storm. Three strips of board arranged as a snow-plough, its iron staple, and a little energy, would form a complete answer to this objection; and the plough once "hitched up," there would be more and better paths made than we usually see about farm buildings.

Placing the house "under cover of a hill," for warmth, was founded on a mistaken theory: in a still, cold night, the mercury goes lowest in the valley. A more effectual protection against wintry blasts, would be a belt or thicket of our native evergreens, planted to windward: there is no such defence against a cutting "nor'easter" as a curtain formed by the numberless leaflets of hemlock and pine, dividing its force into harmless infinitesimal portions.

Instead of doing this, the farmer, in too many cases, plants an impenetrable forest of trees in his front door-yard, so near his house as to completely shut out the life-giving sunlight, not realizing that it is just as necessary to the vigor of its inmates, as it is to that of the corn itself. The very avocation of the farmer calls him out into the sunlight; but his wife and

daughters remain indoors, mostly. He would be amazed to be told that a white, attenuated, cellar-grown potato-vine, and its stout, deep-green, luxuriant congener of the field, present a fair picture of sunlight or *no sunlight*, in its effects on persons as well as things, except that the experiment is carried a little further in the case of the helpless sprout, than in that of the pale, weakly girl who attains her growth and development on the floor above it.

It is safe to say, that in every town in Massachusetts, there is at least one house so densely shaded, that bright, green mosses are thriving on the shingles,—just such mosses as spring up in the deep sunless recesses of the forest, and this, too, on houses not so very old.

A roof where mosses naturally grow is just as much too damp to live *under*, as a soil where willows naturally grow is too damp to live *over*.

By thus planting too many trees too near the house, the very beauty sought is wholly lost: the trees choke and deform each other, and entirely prevent the growth of grass, which, of all rural surroundings, is the most attractive and satisfying. C. D. Warner says, "the Anglo-Saxon race emigrate in the line of grass," and as it utterly refuses to grow in sunless spots, another good, fundamental rule in home-planning would be,—have a wide belt of healthy grass entirely round the house. Then, plant a few trees at such distances as to insure their complete development, in the perfected shape designed by the Great Artificer. Such trees, placed at a proper distance, would lend an air of dignity and repose to the house, and make them seem parts of a complete and harmonious whole, in which the house shows for all that it is, and the trees for all that they are, instead of obliterating each other's lineaments, and "killing" a dwelling to which they should have formed graceful adjuncts.

The "homestead" at present occupied by Bishop Huntington as a summer home, in Hadley, furnishes a fine example of the just arrangement of trees, grass and house,—each seemingly enhances the effect of the others, and all combine to form a rural home of rare dignity and beauty.

So far from discouraging the planting of trees, and attention to the adornment of the home, it is just here that some men,

who pride themselves on their "practical" judgment, make a capital error. They ignore too much that innate love of the beautiful, which is just as often the heritage of the peasant as the king. It is by neglecting these intangible, but irrepressible yearnings for the finer life, that the farmer fails to make a home which his children can love, and is doomed to see them leave it, and seek in other occupations and distant places, those satisfactions which they wholly missed, in what should have been the dearest spot on earth. The charms of a beautiful home would go far to kindle and keep alive that enthusiasm which sustains the soul, enabling it to triumphantly contend against discouragements and obstacles, of which farming, on the relatively sterile soil of New England, has its full share. Whether the sanitarian of the future will push his investigations so far as to be able honestly to write the epitaph, "Died of neglected æsthetics," or not, the statistician of the present is justified in saying, that the sum of human happiness is being constantly subtracted from by the failure to adorn and make pleasant the daily paths of common life.

But, the location chosen, a delusive idea of economy leads the farmer to put a cellar under only half of a house, so planned as to allow of one or more sleeping-rooms on the ground floor.

The prejudice against "going up stairs," and in favor of having a low, sprawling, mud-turtle-shaped house, *is* only a prejudice, but so deeply rooted, that, pernicious as it is, a generation of sound sanitary teaching will be necessary to overturn it. The "low-roofed, spacious farm-house, with the old-fashioned stoop at the back," which has figured in numberless romances, may be picturesque, but, economically considered, it is a failure, and, from a sanitary stand-point, it is condemned, with innumerable pains and penalties annexed.

By making a cellar under only part of the house, the floors of the remaining portion are often so cold that none but the most vigorous persons can maintain warm feet on them; and, as the foundations of this part are seldom carried low enough to resist the action of frost, it soon begins to lean, thus opening cracks, which admit wind and rain, causing damage and vexation, and costing so much in repairs, as to more than neutralize the paltry original saving in excavation and wall.

Were the house properly shaped, having airy sleeping-rooms for the entire family on the second floor, the half-cellar would be sufficient, and the house itself would cost no more, while the roof, the most perishable and troublesome part, would be proportionally diminished in size.

The chimney should be carried down to the bottom of the cellar, and a register inserted, thus forming a perfect ventilating-shaft for carrying off the inevitable effluvia of the roots and vegetables stored there.

There should always be provided, either in the attic of the main house or in the space over the wood-house, a sheltered place for the drying of the weekly wash in cold weather. Many a pneumonia, or fatal lung-fever, has been contracted by going from a heated room and a steaming wash-tub into a zero atmosphere, with the feet on ice or frozen ground, to hang clothes, or, by handling them when frozen, to rescue them from some impending storm.

The neglect of this precaution, and the twin abomination of failing to make a dry and sheltered walk to the privy, which, in itself, presents the climax of cheapness and discomfort, has undoubtedly caused the sacrifice of many valuable lives.

If every farmer in the land could be made to see that the miasma which floats invisible in the upholding sunlight of noonday is precipitated by the chill of night, just as the earth in a glass of muddy water goes to the bottom, when at rest, and that he, sleeping on the ground floor, is aptly represented by a pin lying in that layer of mud, he would conquer his aversion to going up stairs; and, once having tasted the superior charms of a fresh, airy bedroom, away from the smoke and the smells of the roasting and boiling and trying and baking which must be done in every kitchen, he would never again be induced to sleep below stairs.

Too often the window of his ground-floor bedroom opens at the back of the house, in the neighborhood of the outlet to the kitchen sink, so that being opened to prevent suffocation, on a hot summer's night, it admits disease and death in another form. There are no statistics to show how many "heads of families," who have died before their time, by what has been called a "mysterious dispensation of Providence," lost their lives by inhaling the poisonous odors of surface-drains; but,

thanks to modern science, these untimely events are beginning to be justly rated as a species of unwitting suicide, and will ultimately find their true classification, as preventable untimely death.

This matter of kitchen-drains is far too little thought of. Many a tidy housekeeper, whose sink-room is a pattern of cleanliness, and whose sink is as clean as the "plates she eats from," never bestows a thought on the outlet, the care of which, being out of doors, she thinks belongs to the "men folks." Inspection, at this unvisited "back side of the house," would show layer upon layer of decaying potato-sprouts, cabbage-trimmings, onion-tops, etc., etc. They lie just down in the beginning of the slight excavation, which her husband dignifies by the name of a drain, and she thinks nothing about them till they force themselves upon her attention by sheer accumulation. Then, masculine aid is called in, and a few vigorous thrusts with a long pole push the putrescent mass along, out of immediate interfering distance, the wife merely remarking that "the drain did smell awfully when husband fixed it"; but if the poking has happened at the right season of the year, very likely more than one member of the household will have acquired the germs of typhoid, or some other miasmatic disease.

Another wide-spread source of discomfort and ill-health, though happily growing less by the force of circumstances, is the use of feather-beds. These are often precious family heir-looms, and they had an excuse for being while yet stoves and furnaces were unheard of, but are none the less injurious for all that. A coarse sacking, filled with inexpensive straw, forms the "under bed"; on this is laid a huge bag, filled with thirty or thirty-five pounds of feathers. The farmer, with his blood at almost boiling heat, after a day's haying, lies down on this cheap and unpatented vapor-bath and perspirator, and tries to sleep. Is it any wonder that he tosses and groans; that he finds his garments "wringing wet" and himself nearly deliquesced; that he rises with the "first streak of light" from pure misery? The poor wife who, very likely, in addition to all his discomforts, has suckled an infant all night, finds herself more dead than alive in the morning, and looks forward with justifiable shrinking to the tasks of the day, as she

finds "the baby all broken out with prickly heat," and fretful accordingly. No wonder she calls this world "a vale of tears," and considers life a thoroughly puzzling problem.

Had the bedroom been on the second floor, the air would have been sweet and inviting, and the bed should have been formed by placing the feather heir-loom under a mattress (a good hair one would cost $15, and last a lifetime). The baby, also, should have been provided with a well-mattressed crib. The farmer himself would have found that the air circulating about him, as it would, when raised up above, but supported by, an elastic mattress, cooled his blood, and he would have fallen into that refreshing sleep which is real rest. The baby, being cool, would have been mostly spared the eruption, and the mother, having received the full benefit of the mysterious cordial that nature pours through our veins while sleeping, would have risen a rested and renewed being. Feather-beds are answerable for much of the "debility" among farmers' wives.

Not all the detrimental influences are abroad in the soft summer air; each season has its own peculiar dangers to health and life. Take a winter view, and suppose a family of five or six children. In that case, the house will have been raised up, or built out, till some of the sleeping-rooms are remote enough from the kitchen or any other source of warmth.

On winter evenings the household is generally gathered in the family "sitting"-room, and, most likely, round an air-tight stove; probably the cracks around the windows are well calked with rags against any possible ingress of out-door air. A thermometer introduced here would go up to 90°. Bedtime approaches. With shrinking reluctance the youngsters look forward to going to bed in rooms where the walls glitter with frost-sparkles, and the windows are closely curtained with impenetrable sheets of frozen moisture. Anybody who has taken that awful first plunge into a bed as cold as a morgue-slab, and lain awake for an hour with his teeth chattering and every fibre quivering with cold, will realize that the warming-pans of our grandmothers had worthy uses, and will mourn with reason that they have passed out of fashion. Of course, the persons who had been sitting by the air-tight were perspiring freely when they left it, and this sudden change of temperature, with the unavoidable exposure of

undressing, would cause an instant check, in six cases out of ten, sufficient to produce a cold, while in delicate constitutions, and at critical periods, it is quite enough to lay the foundation of incurable maladies.

A properly warmed and ventilated sitting-room, and properly warmed and ventilated sleeping-rooms, would prevent many a pneumonia and consumption.

Another error of modern farm-life is, that the wife tries to do too much herself. This is one of the indirect results of labor-saving machinery. In former days, some needy girl was given a home, and "brought up," often thoroughly initiated into the arts and mysteries of the highest housekeeping, in consideration of her services. Having begun to supply hands and feet by machinery, the housewives of our day carry it too far. To be sure, the human aid is a creature of thought and feeling, of passions and impulses, while the machine causes neither anxiety nor annoyance; and so the wife overtaxes herself rather than "be bothered with a girl."

Now, read the above indictment to the farmer; tell him that each one of its various counts of "ill-built," "ill-ventilated," "ill-warmed," "ill-drained," violates an inexorable, self-executing law. His answer will probably be, "These things are well enough for those who can afford them, but they are not for such as me; it takes a more 'forehanded' man to go into draining, and all that." The proper rejoinder to this is the reply made by the experienced manufacturer to the tyro, who insisted that he could not raise his dam, "because," said he, "it costs too much." "I know it," said the old head; "but it *costs a deal more* not to do it."

It is perfectly easy to show that, by each and all of these errors and neglects, the farmer loses in actual dollars and cents; that an intelligent, vigilant attention to all the known methods of preventing disease and premature death, in the placing and structure and care of a house would, in a series of years, find him richer in tangible material wealth. And who can reckon the bitter cost when violated law avenges itself in some sudden and fatal stroke; or who can compute the misery of seeing some loved one, whose life has been blighted into a prolonged agony, perish by inches?

If there is a wet cellar, and a state of things as hideous as

that described by Mr. French, in the report of last year, twenty-five dollars will cure the dampness, and the labor of one man for half a day will remove all the deleterious accumulations. Many a man who has plead his inability to "spare a day" in the spring, has been forced to take a day in the fall for the obsequies of some member of his household; but not till a long and wearying sickness has taxed to the utmost the energies of all who could wait or watch, and the physician has a large but well-earned bill against him, the druggist another, and the nurse, who was called in when home aid would no longer suffice, another. Had the sums which are often recklessly paid out, in frantic but vain attempts to detain some fleeting life, been invested in judicious methods of *prevention*, they would have been ample to underdrain the entire premises, warm every zero bedroom in the house, and pay the wages of a nimble maid all the year round!

In a home where one or more persons die of miasmatic diseases, it is fair to infer that the survivors labor under disabilities. They suffer from that nameless deficit, which makes them speak of themselves as "debilitated," "miserable," etc. The persistent use of polluted drinking-water, by producing a chronic bowel trouble, that doesn't quite *kill*, transforms living into a heavy burden; the victim of the air-tight stove and icy bed, coughs through the wearisome winter, to find herself "all run down," when the soft spring days arrive; while the pallid girl, who grows up shut out from the sunlight, never knows what it is to live at all.

The men have a little better chance than the women, from their out-door life, but even they do not experience the triumphant delight in living and breathing, which is the rightful guerdon of the tillers of the soil. A man below par in health can hardly be expected to act up to the full measure of a completed manhood, so that our account will not be fully made up till we have added a dismal inventory of possibilities unfulfilled, worthy purposes unachieved and reasonable hopes forever deferred. Is it any wonder that he is easily discouraged, that he gives way to morbid repinings and ignoble discontent, that he envies the professional man, and actually imagines that the lot of the hard-worked city clerk, with all its deprivations, is better than his own?

Having reckoned up the terrible wages of ignorance and neglect, there is still another rejoinder to the farmer's plea of "can't afford it"; that is, to show him how he wastes his substance and spends his strength for naught, in unthinking and servile obedience to custom,—in following fashions that are absolutely senseless. How much money is spent annually in Massachusetts in maintaining a vivid coat of white paint, not only on farm-houses, but on miles and miles of elaborate picket-fences, which shut nothing in, and keep nothing out, arranged in squares about the houses, so small as to suggest city areas, and which deform the landscape, with no other apology than that "everybody has them." The true farm-house should have no fence so near it as to detract from the impression of the *farm*. Why should "broad acres" pretend that they are only door-yards? The house itself, with only its outlines tinted, and the rest left to turn to a weather-brown, would, by and by, soften and blend into the landscape, and with everything tidy and well kept about it, would become an attractive object. The farmer should take every possible measure to insure the rosy bloom of health on the cheeks of his children, before he spends a cent in producing some particular shade on his buildings.

Another item of idle costliness is the Yankee housewife's prime superstition of a "best room," often occupying the sunniest corner of the house, but remaining unopened and unused, perpetually sinking, in its carpet and furniture, a sum sufficient to make every other apartment thoroughly healthful and comfortable.

These, and the vast sums annually worse than squandered on the oceans of patent medicines consumed in the farm-houses of our State, if intelligently expended to prevent disease and procure comfort, would transform the lives of thousands and raise them to a higher level.

The farmer of Massachusetts does not sufficiently value "*comfort*," that complete physical satisfaction, which the ceaseless investigations of an army of sanitarians are demonstrating is but another name for high health. These are daily and hourly proving that every advance in that is a distinct step towards long life.

Without claiming that sanitary science "is a department of religion," in urging earnest attention to physical health as a first duty, we are following the divine order of Him who fed the hungry and healed the infirm before he addressed them in the language of admonition, or looked for spiritual fruits in their lives.

REPORT ON THE EPIDEMIC

OF

CEREBRO-SPINAL MENINGITIS

IN

MASSACHUSETTS

IN

1873.

WITH SOME INQUIRY INTO THE CIRCUMSTANCES ATTENDING ITS ORIGIN OR SUPPOSED CAUSE.

By J. BAXTER UPHAM, M.D.

CEREBRO-SPINAL MENINGITIS IN MASSACHUSETTS.

The disease now denominated cerebro-spinal meningitis has long been known to the medical profession in the various countries of the civilized world. It has existed as an epidemic, at stated times, in Russia, Holland, France, Germany, Spain, Portugal, Sweden and Great Britain. It has occurred also, from time to time, under various names and divers forms and phases of development, in many parts of our own land. During the war of the rebellion it was seen in marked and fatal form in some of the important military posts both West and South. It was the fortune of the writer to observe the disease in its epidemic character as it occurred in the camps in and about the town of Newbern, in North Carolina, in the winter and spring of 1862–63. This was one of the first among its recent visitations as an epidemic in the United States. * So long, indeed, had the affection been dropped from the catalogue of our prevailing diseases that, at first, the whole medical force in that Department were at a loss to know with what they had to deal. Coming, as it did, suddenly and without warning, it early arrested attention by the abruptness and intensity of the attack, the peculiarity of its symptoms, its protean developments, its oftentimes rapid course and fearfully fatal results. By some it was taken to be a new and unusual phase of intermittent fever; by others a severe malarial fever of the bilious remittent type; by others still, a malignant typhus, identical in its essential elements with the endemic fever of Great Britain, and which, under the various titles of hospital, jail or camp fever, putrid malignant fever, petechial fever, maculated typhus or ship fever, and other ill-favored names, "is known to lurk in the track of armies, and is familiar in the hovels and ill-drained and ill-ventilated houses of the poor and wretched"—with each and all which affections it seemed to present many symptoms

in common. It was not, indeed, till repeated post-mortem investigations revealed the unmistakable and striking lesions which belong to the disease in question, that its true character was recognized and established.

To give, in briefest form, a portraiture of the disease as it is now understood by the medical profession, I quote the following definition from a recent admirable monograph on this subject by Dr. Meredith Clymer,* as follows, viz.: "*An acute specific disorder, commonly happening in an epidemic, general or limited, and, rarely, sporadically,—caused by some unknown external influence,—of sudden onset, rapid course and very fatal; its chief symptoms, referable to the cerebro-spinal axis, are great prostration of the vital powers, severe pain in the head and along the spinal column, delirium, tetanic and, occasionally, clonic spasms and cutaneous hyperæsthesia, with, in some cases, stupor, coma and motor paralysis, attended frequently with cutaneous hæmic spots; the morbid anatomical characters being congestion and inflammation of the membranes of the brain and spinal cord, particularly the pia mater, although there is reason to believe that the evidence of these changes may be wanting, even in cases of long duration.*"

To this succinct and comprehensive, but purely technical, definition, it may not be out of place to add here some account of the essential characteristics of the disease, its habits, symptoms, progress and pathology, as seen in its epidemic and most prevalent form in this country. In its mode of attack it is commonly sudden and without premonition, the patient, for the most part, continuing about his ordinary duties and making no complaint till the very day of his seizure. The subjects of the disease, in most cases, among adults, and males especially, are those who have previously been in the enjoyment of sound and robust health, and have endured hardship and exposure with impunity. The symptoms at the first are headache, referred mostly to the back part of the head, of a severe, oftentimes excruciating, character; conjoined with this, or soon following, are violent pains in the nape of the

* Epidemic Cerebro-spinal Meningitis, *with an Appendix* on some points on the Causes of the Disease, as shown by the History of the recent Epidemic in the city of New York. By Meredith Clymer, M.D. (*Univ. Penn.*), etc., etc. Philadelphia: Lindsay & Blakiston. 1872.

neck, extending down the spine, accompanied with a peculiar sense of stiffness in the muscles of the neck and lower part of the face. There is chilliness rather than a well-defined chill. Nausea and vomiting, in children especially, is an early symptom. There is generally soreness and tenderness at the back of the neck and along the spine. Sudden and acute pains in the joints is a not infrequent concomitant. As the disease advances there is great exhaustion; the breathing becomes irregular and labored. Delirium is frequently present, often of a violent kind, but differing from the delirium of typhoid and typhus fever in that the patient can easily be aroused so as to answer questions intelligently. There may be, at some stage of the affection, an eruption of a dark-red or purplish hue, of a hæmic character, not raised but apparently imbedded in the substance of the skin. This eruption is by no means a constant phenomenon, nor is it confined to any particular portion of the body. There is usually much nervous agitation, manifested by a constant restlessness and jactitation. The muscles of the neck become rigid and contracted, drawing the head backward to almost a right angle with the thorax; this, although not a constant symptom, is mostly seen, or at least a tendency to this condition is noticed, at some period of the disease. There may be also tetanic and clonic spasms. The action of the heart is irregular and tumultuous, so as often to simulate valvular disease of that organ. An inflammatory condition of the iris, or of the synovial membrane of the larger joints is often an accompaniment. Sueh are among the more prominent and constant symptoms. But there is a considerable diversity in these manifestations during the progress of the disease, whether towards a favorable or fatal result; in no individual case can it be expected that all, or even a majority, of those above enumerated will be present.

The *duration* of the disease is very uncertain. It may last less than twelve hours, or it may extend, with its complications and sequelæ, to as many weeks, or, perhaps months; the greater number of fatal cases terminate on or before the seventh day. Cases are on record in which death has occurred within two or three hours from the time of seizure.

No *age* is exempt; nor would there seem to be any preference of *sex*. Children are, perhaps, more commonly subjects of

the disease. Statistics show that more cases occur under than over the age of ten years.

The *mortality* is very great, averaging in many well-marked epidemics of which we have record fully 67 per cent. In the visitation at Newbern, before alluded to, the mortality of all the recorded cases was 73 per cent.; in the city of New York, in 1872, it was 75 per cent.; in the epidemic that occurred in this State, in 1866, it was 61 per cent.

The *prognosis* must be regarded as doubtful from the first; of no disease is it more hazardous to base upon existing favorable or unfavorable symptoms a positive prediction as to the result. Convalescence is usually slow and relapses not infrequent.

As to the *season of the year* when epidemics of this affection are most apt to prevail, not much that is satisfactory can be learned. Dr. Simon has stated that, of 182 European epidemics, 24 were in October and November, 46 in December and January, 48 in February and March, 30 in April and May, 24 in June and July, and 10 in August and September. Dr. Clymer, who has collected the statistics of many epidemics, says that, in Sweden, of 417 local outbreaks, 311 were in winter and 106 in summer; that, of epidemics in Europe and the United States, noted by Hirsch, 33 prevailed in winter, 24 in winter and spring, 11 in spring, one in spring and summer, two in summer, one in summer and autumn, one in autumn, one in autumn and winter, three in autumn, winter and spring, and six throughout the whole year. Pleiffer says "it prefers winter, soldiers and children."

It would be out of place here to enter largely into the consideration of the *nature and pathology* of the disease. Suffice it to say that the weight of evidence is in favor of placing it in the category of those diseases which are engendered by the existence of a morbid poison acting primarily upon the vital fluid, and secondarily affecting more especially the meninges of the base of the brain and spinal cord, where, upon dissection, its material lesions can most often be found.

The etiology, or *cause of the disease*, is still involved in doubt. It will be our aim to consider, with minuteness and impartiality, the mass of evidence collected from the many

intelligent observers of the present epidemic, and to deduce, if we can, something that may prove of use in the prevention or management of future visitations of a like nature.

Before entering upon a discussion of the existing epidemic, let us glance at the past history of the affection within the limits of our own State. The first reliable record of it, as seen in the epidemic form in Massachusetts, dates back to 1806, when it appeared in the town of Medfield. Nine cases occurred in that town, all of which proved fatal. This was in the month of March. From that time until 1816 it appeared, at intervals, at various points within the State, and was more or less epidemic in its character. It prevailed quite extensively in 1810. In that year a most interesting report upon this then mysterious and obscure affection was drawn up and published by Drs. James Jackson and John C. Warren. It first appeared, as stated in that report, in the town of Dana, about the beginning of the year, "but not in any considerable number of instances until the cold weather of the middle of January." In the latter part of February it was heard of at Petersham, and at Barre, Oakham, Rutland, Paxton, Hardwick, New Braintree, Brookfield, Spencer, Sturbridge, Winchendon, Athol, Gerry, Leicester and Worcester, in the course of the month of March, "mostly about the third week in that month." It will be seen that all the above-named towns are in the county of Worcester. It was seen at Cambridgeport in the latter part of March, and at Lancaster in April. In the course of April and May a few cases occurred at Boston, and again in the counties of Worcester and Middlesex. During May it presented itself in Springfield, and had not subsided in the second week in June.* We hear little or nothing more of the disease till 1849, when Dr. Joseph Sargent, of Worcester, called the attention of the profession to its existence in the towns of Millbury and Sutton during the month of March of that year. Not many cases were seen, however, and if the disease could then be called epidemic at all, it was limited both in quantity and extent. Dr. S., in this memoir, first suggested the analogy of the

* See Report of the Committee of the Mass. Med. Soc'y, May, 1866, Luther Parks, M.D., Chairman.

disease with the so-called "spotted fever" of a former day.* It appeared again, to a limited extent, in April, 1857, in the town of Becket, in Berkshire County. Dr. Jackson stated that he had occasionally met with sporadic (isolated) cases of the disease in later years, or since the epidemic of 1806-16.† Since about the time of the outbreak of the disease among our soldiers during the war, it has made its appearance at various points in this State. Five cases came under the observation of the writer, in the Boston City Hospital, in 1865-6. Some of these cases originated in the hospital. Dr. Page saw a considerable number of cases, near the close of the war, at Gallop's Island, a military post in Boston Harbor.

The report of the committee from the Massachusetts Medical Society, in 1866, covers all the cases which could be collected in the State from 1857 to 1865 inclusive,—280 in all. These were distributed over the different years as follows:—

In 1857 there were	3	cases.
1858 " "	27	"
1859 " "	3	"
1861 " "	5	"
1862 " "	5	"
1863 " "	7	"
1864 " "	88	"
1865 " "	116	"
Years not designated,	26	"
Making a total of	280	cases.

From the above it appears that instances of the disease have occurred in this State in each year from 1857 to 1865, inclusive, with the exception of 1860. Doubtless a considerable number of cases might have been chronicled in 1866, but the report did not include the record of that year, other than the mention of seven cases in Brookline, in January.

* Records of the Boston Society for Medical Improvement, 1849.

† Extract of a letter from the late Dr. James Jackson to Dr. L. Parks, in 1866. See report of the Committee of the Massachusetts Medical Society for that year.

I am not able to find any reliable account of the number of cases of this affection which have occurred from 1866 to 1871, inclusive. Neither the state or city registration reports render much assistance in this investigation. In the former, the nosological term, cerebro-spinal meningitis, does not appear. We have the right to infer, however, from an actual knowledge of the existence of the disease, to a greater or less extent, in these years, that it may be embraced within the term "cephalitis," under which all the inflammatory affections of the brain and its coverings seem to have been classed. Among the causes of death for the years below stated, the number attributed to "cephalitis" stands as follows:—

In 1863, ...	524
1864, ...	728
1865, ...	669
1866, ...	595
1867, ...	525
1868, ...	577
1869, ...	572
1870, ...	601
1871, ...	620

We would call attention to the fact that in the years 1864 and 1865 the disease was known to be epidemic in many portions of the State; and the greater number of deaths attributed to "cephalitis" in these epidemic years tends to confirm our opinion that the disease existed, and was reported under the above title. In 1872 it appears for the first time in the state nosological records under its true name, 157 *deaths* being returned as occurring from cerebro-spinal meningitis, 16 from spotted fever, and two from black fever, all which were supposed to be cases of the affection now under consideration. In his annual report for 1872, the city registrar states that the whole number of deaths in Boston from this cause in that year was 60, of which number 34 were males and 26 were females. He further says that in 1867, when this disease was first distinctively reported to him, under its present name, there were seven

deaths; in 1868, eight; in 1869, seven; in 1870, five; and in 1871, three.*

During the early months of the present year it became evident that the disease had again assumed an epidemic form, and was prevailing to an unusual extent, in the eastern portions of the State especially. In the month of May a notice was inserted in the Boston Medical and Surgical Journal, calling the attention of physicians to this fact, and asking their aid and co-operation in collecting statistics. Subsequently a circular was issued by the Secretary of the State Board of Health, and distributed to his regular correspondents throughout the State. This circular contained the following questions :—

1. How many cases of this disease have come within your knowledge or observation within the present year?

(*If no cases have been observed, please give a negative reply.*)

2. State the sex, nationality, age, and occupation of the patients.

3. Character of the attack, whether sudden or otherwise.

* The distribution of deaths attributed to this disease in 1872 will appear from the following table.

COUNTY.	Town.	Deaths.	COUNTY.	Town.	Deaths.
Barnstable,	Orleans,	1	Plymouth,	Abington,	1
Berkshire,	Adams,	5		Mattapoisett,	1
	Gt. Barrington,	2	Suffolk,	Boston,	63
	Lenox,	1		Chelsea,	1
	Williamstown,	1	Worcester,	Ashburnham,	1
Bristol,	Fall River,	2[1]		Berlin,	1
Essex,	Amesbury,	2		Clinton,	1
	Danvers,	2		Grafton,	4
	Essex,	1		Hardwick,	1
	Salem,	1		Holden,	1
	Topsfield,	1		Hubbardston,	1
Franklin,	Warwick,	1		Lancaster,	1
Hampden,	Chicopee,	1		Mendon,	2
	Holyoke,	3		Milford,	5
	Springfield,	5		Northbridge,	1
Hampshire,	Enfield,	1		N. Brookfield,	1
	Hadley,	1		Oxford,	1
	Southampton,	1		Royalston,	2
Middlesex,	Littleton,	2		Southboro',	2
	Lowell,	1		Sterling,	1
	Marlborough,	18		Sutton,	1
	Melrose,	1		Upton,	6
	Natick,	7		Webster,	2
	Somerville,	1		Winchendon,	1
	Tewksbury,	1		Worcester,	5
Norfolk,	Brookline,	2			
	Hyde Park,	1			175
	Quincy,	1			
	West Roxbury,	1			

[1] Black fever.

4. Stage of the disease when the patient was first seen.

5. The earlier and later symptoms.

6. The duration of the disease.

7. The treatment.

8. The result.

9. The post-mortem developments, when obtained.

10. Name of the attending physician.

11. Has the disease prevailed among *animals*,—horses, cows, hens, etc.? If so, please state the symptoms and pathological appearances when possible.

12. General remarks upon the case, *with especial reference to its supposed origin or cause.* In this connection a detailed account of the locality, hygienic conditions and circumstances of the patient,—his home and home surroundings, living-rooms, cellar, sinks and privies, nature of the soil, drainage, character of the water used for drinking and culinary purposes, etc., etc., is especially desired.

And for the greater convenience of record, when a considerable number of cases had been observed, a tabular form, with headings indicating the desired points of information, was added.

Replies have been received from 199 physicians, representing 77 towns and cities, who have furnished the statistics, more or less complete, of 517 cases of the disease. In this enumeration we have retained only those instances which we believe to be genuine and authentic. The following will serve as examples of these tabular returns received from various parts of the State:—

Tabular Statement *of Cases of Cerebro-Spinal Meningitis*

No. of Case.	Name of City or Town.	Name, Nationality, and Occupation.	Age.	Condition—Easy or otherwise.	Date of Attack.	Onset—Sudden or otherwise.	No. of Hours or Days ill before Seen.
1	Boston, .	M. L. C., Domestic, Canada.	18	Comfortable.	Mar. 15,	Sudden,	One day.
2	Fitchburg, .	W. F., . .	13	Easy, .	May 16,	Sudden,	16 hours.
3	Haverhill, .	Mrs. S., American.	27	Good, .	Apr. 15,	Sudden,	Seen at once.
4	Leominster.	S. W., American.	60	Not destitute, but with limited and gradually diminishing means.	July 28,	Sudden,	16 hours.
5	Worcester, .	G. M., American.	5	Easy, .	Apr. 14.	Sudden,	2 days.

occurring in Massachusetts during the Epidemic of 1873.

Symptoms.	
Early.	Advanced.
Vomiting of bilious matter. Severe headache; pain in back, and stiffness of right leg. Delirium at night. Pain of head referred to forehead; and of back in upper cervical and lower dorsal vertebræ, where she is tender on pressure. Slight deafness. Temperature, 102°.	Pain as at first. Delirium at times. Pulse, 72–140; small, weak. Hearing good at times. Temperature, 101°–104°. Patient failed rapidly on fifth day. No convulsions. No eruption.
Vomiting. Pain in head, and general febrile symptoms. Severe pain in back of head and neck. Appetite continued good until a few hours before death.	Rapid pulse, pain in head; stiffness of spine, and tenderness, especially in cervical region. Sank rapidly and died, without premonition, apparently from paralysis of respiratory muscles. At death, pulse at wrist full, strong—130 per minute; heart continued to beat for two or three minutes after respiration had ceased, when the action became slower, feebler, and ceased entirely. I was present at death.
Violent pain in back; spasms. Unconsciousness.	Symptoms continued in modified form for two weeks.
Intense pain in head, with rapid pulse and high fever; dry skin; bilious vomiting, with remissions of pain in head transferred to back, particularly lower part of back. This, at times, intense, with paralysis of bladder for eight days in second and third weeks, requiring use of catheter twice a day; after that the bladder resumed its action.	Paroxysms of pain in head and back gradually subsiding; stiffness of muscles of neck and lower jaw, with difficult deglutition; no appetite; gradual failing of vital powers.
No marked rigor. Pain in head and back of neck; vomiting; convulsions; fever; delirium; retraction of head; tenderness along cervical portion of spine; large herpetic cluster upon back of left hand; no other eruption.	Profound *insensibility;* pallor, alternating with flushings of the face; slow, feeble pulse; strabismus, with dilated and insensible pupils; complete hemiplegia of right side, lasting for two weeks; constant jactitation of left arm and leg; great emaciation.

Tabular Statement of Cases of Cerebro-Spinal Meningitis

No. of Case.	Relapses, or Decided Remissions.	Duration, till Convalescence or Death.	Treatment.	Result.
1	Some relief to pain under treatment.	Five days.	Morph. Sulph. at first for pain and restlessness. Second day, Fl. Extract Ergot. m. xx. Potass. Bromid. gr. v. 2d h. Third day, Ergot omitted, and Potass. Br. increased to gr. xx. with Extract Cannabis Ind. gr. ⅛ 2d h. Fourth day, pain much relieved.	Death.
2	Quite a marked remission after 12 hours.	48 hours from first attack.	First saw the patient at evening; gave morphia until sleep, quiet and refreshing, ensued. Morning found apparent convalescence; pulse 80, and nearly normal. Directed quiet, stimulants to spine with diuretics. At 4, P. M., patient suddenly grew worse, became unconscious, and died at 10, P. M.	Death.
3	Severe relapse May 4th.	Five weeks.	Counterirritation vigorously applied. Bromide Potass. Hyd. chloral. Sulph. Quiniæ.	Recovery.
4	None, .	7 weeks and 2 days.	At onset emetic—cathartics—then cold to head; counterirritants to spine; blisters to nuchæ, temples, back of ears, &c. Paroxysms of pain subdued by sub-cutaneous injection of morphine—sleep induced by choral. After the acute stage—2 weeks—beef-tea, broth, milk-punch, &c., all the patient would take, which was not much, and only at our earnest solicitation. He gradually sank from exhaustion.	Death.
5	None, .	Duration, to complete convalescence, about 3 months. Under treatment, seven weeks.	Early: cold applications to head and spine; evacuation of bowels. Potass. Bromid. ev. 4 hours, and Chloral and Opium p. r. n. Advanced: nourishment, Potass. Iod., Hydrarg. Bichlorid., and as convalescence became established, Iron.	Recovery complete.

occurring in Massachusetts during 1873—Concluded.

Post-Mortem Developments.	Locality — High or Low, Damp or Dry.	Name of Attending Physician.	Remarks, with especial reference to Origin or Supposed Cause.
No autopsy.	Residence not known.	Dr. Abbot.	This was a patient in the Massachusetts General Hospital, where she entered on the second day of her sickness, and remained until her death.
No post-mortem.	House situated on the bank of an artificial reservoir, into which a sewer is drained.	Dr. Jewett.	The home of this patient is at the lowest part of a valley. House stands on the shore of an artificial reservoir, which is used almost daily for a mill; surface of the pond is constantly changing, leaving the bottom frequently exposed to the sun and air. Into this pond several privies and a sewer are emptied. My opinion is, that both the air and drinking-water are poisoned, and that to these sources we may look for cause of the disease.
-	Street well drained. Clay bottom; cellar damp.	Dr. Crowell.	New house with modern conveniences. Tenement on north side. Good family. The street sloped abruptly toward the river, on the south. Surface-drainage good. Pure aqueduct water used.
No autopsy.	Low and damp.	Dr. Field, .	I consider the proximate cause to be this—the falling asleep on the ground after a hard day's work. A life of hard work and gradually diminishing pecuniary means may be considered as remote causes. Perhaps the water used by the family, taken from a neighboring pond, may have had something to do in causing the disease.
-	High, dry, sandy soil.	Dr. Gage.	This case was isolated. There were no others in the family or neighborhood. The house was apart from others, upon high ground, and surrounded by trees, and the surroundings appeared to be every way of the most favorable character. Convalescence was very slow. Intellect for a long time very weak, but finally fully restored. Command of lower limbs was very slowly regained. Strabismus continued for three months, but at last entirely disappeared.

The following table will show the towns from which affirmative replies have been received, and the number of cases reported in each, with the population in 1870.

CITIES AND TOWNS.	Population in 1870.	No. of Cases.	CITIES AND TOWNS.	Population in 1870.	No. of Cases.
Abington,	9,308	9	Lowell,	40,928	48
Amherst,	4,035	3	Lynn,	28,233	48
Andover,	4,873	4	Marblehead,	7,703	8
Ashland,	2,186	2	Methuen,	2,959	1
Attleborough,	6,769	1	Mattapoisett,	1,361	1
Belchertown,	2,428	3	Millbury,	4,397	5
Beverly,	6,507	3	Milford,	9,890	9
Boston,	250,526	50	Newburyport,	12,595	2
" City Hospit'l,	–	16	New Bedford,	21,320	1
" Mass. Gen. H.	–	2	New Marlborough,	1,855	1
" Dorch. Dist.,	–	2	New Salem,	987	2
" Roxbury "	–	7	Newton,	12,825	4
		—77	N. Bridgewater,	8,007	4
Braintree,	3,948	7	Northampton,	10,160	3
Bradford,	2,014	1	North Brookfield,	3,343	3
Brighton,	4,967	6	Palmer,	3,631	1
Brookfield,	2,527	2	Peabody,	7,343	3
Brookline,	6,650	3	Prescott,	541	1
Cambridge,	39,634	17	" North,	–	3
" East,	–	1			— 4
" North,	–	1	Quincy (Point),	7,442	1
		—19	West Brookfield,	1,842	1
Cambridgeport,	–	7	West Roxbury,	8,683	2
Charlestown,	28,323	28	Salem,	24,117	5
Chelsea,	18,547	11	Salisbury,	3,776	3
Chicopee,	9,607	10	Sandwich,	3,694	1
Clinton,	5,429	2	Saugus,	2,247	1
Dedham,	7,342	8	Shrewsbury,	1,610	2
Dudley,	2,388	1	Somerville,	14,685	6
Everett,	2,220	7	South Hadley,	2,840	1
Fall River,	26,766	6	Springfield,	26,703	12
Fitchburg,	11,260	2	Stoughton,	4,914	7
Great Barrington,	4,320	1	Swampscott,	1,846	2
Hadley,	2,301	1	Tyngsborough,	629	3
Haverhill,	13,092	18	Watertown,	4,320	5
Hingham,	4,422	2	Webster,	4,763	5
Holyoke,	10,733	5	Westfield,	6,519	1
Hubbardston,	1,654	2	Weymouth,	9,010	2
Lawrence,	28,921	15	Winchester,	2,645	1
Leicester,	2,768	2	Winchendon,	3,398	6
Leominster,	3,894	20	Woburn,	8,560	4
Leverett,	877	1	Worcester,	41,105	7
Lexington,	2,277	2			

The following are the towns from which negative replies have been received :—

Ashby, Barre, Berlin, Billerica, South Boston (Hospital), Bridgewater, Enfield, Essex, Fairhaven, Falmouth, Granby, Halifax, Hopkinton, Hyde Park, Ipswich, Jamaica Plain, Kingston, Longmeadow, Manchester, Marlborough, Montague, Nantucket, North Andover, North Brookfield, Orleans, Plymouth, Reading, Rowe, Sharon, Sherborn, Shirley, Stockbridge, Stoneham, Wakefield, Walpole, Waltham, Ware, Wareham, Wenham, West Boylston, West Springfield and Williamstown.

The period embraced in this investigation covers only the year 1873, and relates mainly to the first ten months of the year, since the time did not allow us to keep the record open longer. Such cases, however, as could be collected in November and December are included in our count.

We do not presume to have presented a full return of all the cases which have occurred within the limits of the State during this period. A considerable number of physicians, to whom circulars were sent, failed to reply either affirmatively or negatively. In many instances it was stated that the disease existed, but "no notes of the cases had been preserved." In many instances also the record of such as were given was insufficient to warrant an opinion of the true character of the affection. It will be seen, however, that with all these limitations the aggregate of cases far exceeds the number adduced in any former epidemic of which we have record in the State.

In elucidation of the character of the present epidemic, and as having a possible bearing upon its origin or supposed cause, we make the following extracts from the tabular returns and medical correspondence called forth by the circulars :—

Abington.—Dr. Gleason reports nine cases, the location of which is said to be "good" in six, "low or damp" in three. Two of these patients, aged 7 and 11, were pupils in a day-school.

Amherst.—Three cases reported. In two there was "no appreciable cause. Hygienic conditions excellent in every respect." In one, "hygienic condition very unhealthy: the house low and damp, situated in a hollow; the yard, at the time, filled with the wash of the surrounding nastiness; and the drinking-water coming from a well in the middle of the yard." Dr. D. B. N. Fish writes from this place as follows:—"In the spring many diseases took

on a condition of great depression, with slow pulse, much restlessness, sighing, respiration, etc., resembling that of epidemic cerebro-spinal meningitis, of which disease there were several cases in this vicinity at that time."

Ashland.—"Two cases reported. Cause not appreciable. Sanitary surroundings of the patients good: the soil a deep, heavy, sandy loam with a gravelly subsoil; natural drainage good; the cellars a little damp."

Andover.—Dr. Kimball reports four cases. In one case the location was dry; in two cases it was dry, but near a pond or running stream; in one it was "rather damp." Nothing definite is stated as to origin or supposed cause; two of the cases followed exposure to wet and cold after very violent exercise.

Attleborough.—Dr. Sanford reports a single case. "Patient was robust, active and athletic. Of origin or supposed cause," he says, "nothing can be stated."

Belchertown.—Three cases reported. In two, "locality low, the patients being occupants of an Irish shanty on the bank of a river so swollen at the time as almost to reach the threshold of the house; no conveniences of any kind." In one case the disease supervened upon typhoid fever. This patient "was from a good family, but had been overworked, both physically and mentally,—was away from home at school when seized with the fever, and living in a very damp location."

Beverly.—Three cases are reported by Dr. Haddock. In one instance the locality was high; in two it was low.

Boston.—The records of the city registrar show that 216 deaths were attributed to this disease in 1873. Of this number, 100 were males and 104 females; in 12 the sex was not stated. The first case was recorded on the 11th day of January. I have been able, through the courtesy of Mr. Appollonio, to obtain the dates and fix upon the exact locality of 204 of these reported cases, as will appear in the following table:—

Table showing the Deaths *attributed to Cerebro-Spinal Meningitis in Boston in 1873—Taken from Books of the City Registrar.*

Month.	Sex.	Street and Number.	Ward.
Jan. 1st to Jan. 23d.	F.	9 Oxford Place,	V.
	F.	70 Warren Street,	XIV.
	M.	144 Portland Street,	IV.
		Not stated.	
Jan. 24th to Feb. 19, inc.	M.	12 Hollis Place,	VIII.
	M.	44 Parkman St.,	III.
	F.	Tremont Street,	XV.
	M.	Deer Island.	
	M.	35 Adams Street,	XIII.
	M.	22 Liverpool St.,	I.
	F.	11 Franks Street,	IV.
February 20th to March 17th, inclusive.	M.	22 Ferry Street,	II.
	F.	18 Norfolk Place,	V.
	F.	57 Anderson St.,	VI.
	F.	Fulton Street,	XVI.
	M.	17 Rochester St.,	VII.
	M.	40 Billerica Street,	III.
	M.	17 Maverick St.,	I.
	F.	65 Brighton St.,	III.
	M.	90 Fifth Street,	VII.
	F.	100 Kendall Street,	XI.
	M.	155 Saratoga Street,	I.
	M.	98 Brookline St.,	X.
	F.	36 Lampson St.,	IX.
	F.	57 Williams St.,	XIV.
	M.	234 Hanover St.,	II.
	M.	61 Bower Street,	XIV.
	M.	453 Shawmut Av.,	XI.
	M.	Rogers Av.,	XV.
	M.	199 Silver Street,	VII.
		Not stated.	
	M.	Mass. Genl. H.	
	F.	10 Genessee St.,	VII.
	F.	6 Lark Street,	XII.
	F.	2 Clifford Place,	II.
	F.	29 Cove Place,	VII.
	M.	160 Chelsea Street,	I.
	F.	91 Charter Street,	II.
March 18th to April 14th, inclusive.	M.	89 Sixth Street,	XII.
	F.	58 Baxter Street,	VII.
	F.	Mass. Genl. H.	
	M.	Heath Street,	XV.
	F.	124 Mt. Vernon St.,	VI.
	M.	6 Lark Street,	XII.
	M.	18 Minot Street,	III.
	M.	19 Margaret Street,	II.
	F.	City Hospital.	
	F.	3 Irving Place,	VI.
	F.	45 Sharon Street,	XI.
	F.	987 Tremont St.,	XV.
	F.	144 Third Street,	VII.
	M.	21 Hanson Street,	X.
	F.	Shamrock St.,	XVI.
	M.	City Hospital.	
	F.	320 Sumner Street,	I.
	F.	6 Gold Street,	VII.
	M.	28 Yeoman St.,	XIII.
		Not stated.	
March 18th to April 14th, inclusive—*Con.*	M.	City Hospital.	
	M.	Franklin Street,	XVI.
	F.	138 Mt. Vernon St.,	VI.
	F.	39 Ellery Street,	XII.
	M.	Bowdoin Sq.,	XVI.
	F.	45 Athens Street,	VII.
	M.	7 Travers Court,	XI.
	F.	100 Hudson Street,	VIII.
	F.	Fellows Street,	XIII.
		Not stated.	
	M.	23 Maverick Sq.,	I.
	F.	Dorchester Av.,	XVI.
	F.	11 Riverside St.,	XV.
	F.	15 Gouch Street,	IV.
	M.	42 Tileston Street,	II.
	M.	Deer Island.	
	F.	3 Wadleigh Pl.,	XII.
	F.	693 Washington St.,	VIII.
	F.	Tremont House,	IV.
	M.	3 Rutland Place,	XI.
	F.	1094 Shawmut Av.,	XIV.
	M.	Broadway Ct.,	VII.
	F.	47 Oswego Street,	VII.
	F.	183 Endicott Street,	II.
	F.	352 Third Street,	XII.
	F.	42 Yeoman Street,	XIII.
	M.	31 North Square,	II.
	F.	46 Piedmont St.,	IX.
	F.	2059 Washington St.,	XV.
	M.	239 Trenton Street,	I.
	M.	122 Sumner Street,	I.
	M.	10 Bridge Street,	III.
	M.	31 Billerica Street,	III.
April 15th to May 13th, inclusive.	M.	36 Cottage Street,	I.
	F.	39 E. Dedham St.,	X.
	M.	Harrison Sq.,	XVI.
	F.	59 Endicott Street,	II.
	M.	4 Buttrick Place,	II.
	M.	16 B Street,	VII.
	M.	5 Maverick St.,	I.
	F.	City Hospital.	
	M.	3 Watts Court,	XII.
	M.	9 Meander Street,	X.
	F.	Morni Court,	XII.
	M.	City Hospital.	
	F.	Mass. Hotel,	II.
	M.	41 Haynes Street	I.
	F.	120 Havre Street,	I.
	F.	2 Carver Place,	VIII.
	F.	200 Marion Street,	I.
	F.	141 Eighth Street,	XII.
	M.	20 Havre Street,	I.
	M.	48 Williams Street,	XIV.
	M.	Neponset Av.,	XVI.
	M.	145 Harrison Av.,	VIII.
	M.	City Hospital.	
	M.	39 Gooch Street,	IV.
	M.	10 Cottage Place,	XV.
	F.	581 Shawmut Av.,	XI.
	F.	5 K Street,	XII.

DEATHS *by Cerebro-Spinal Meningitis*—Concluded.

Month.	Sex.	Street and Number.	Ward.	Month.	Sex.	Street and Number.	Ward.
April 15th to May 13th, inclusive—*Con.*	M.	26 Grenville Street,	IX.	June 16 to July 15, inc.	M.	47 Vale Street,	XV.
	F.	12 Beacon Street,	IV.		M.	35 Rochester St.,	VII.
	M.	270 Athens Street,	VII.		F.	119 Charlestown St.,	II.
	F.	3 Texas Court,	XV.		M.	15 Bennet Street,	II.
	M.	49 Cedar Street,	XVI.		F.	635 Harrison Av.,	X.
	M.	4 Hope Street,	III.		M.	3 Meridian Place,	I,
	F.	26 Traverse Street,	IV.		M.	7 Quincy Street,	XIV.
	F.	101 Norfolk Av.,	XIII.		M.	17 Dale Avenue,	XV.
	M.	976 Harrison Av.,	XIII.		F.	126 Broadway,	VII.
	F.	986 Harrison Av.,	X.		M.	14 Burroughs St.,	VIII.
	M.	249 Shawmut Av.,	X.		M.	City Hospital.	
	M.	609 Harrison Av.,	X.		F.	980 Harrison Av.,	XIII.
	M.	246 Shawmut Av.,	X.		F.	2 Utica Place,	VII.
	F.	284 Federal Street,	V.			Not stated.	
	M.	90 Fifth Street,	VII.				
	M.	15 Clark Street,	II.				
	F.	Rockingham Pl.,	XIV.	July 16 to Aug. 6.	M.	Breed's Island,	I.
	F.	Swett Street,	XIII.		F.	11 Stillman Street,	II.
	F.	291 Fourth Street,	VII.		F.	28 King Street,	XV.
	F.	27 Billerica Street,	III.		F.	238 Harrison Av.,	VIII.
	M.	45 Sharon Street,	XI.		M.	139 Hampden St.,	XIII.
	M.	5 Saxon Court,	I.			Not stated.	
	M.	5 River Street,	VI.		M.	154 Bremen Street,	I.
	F.	37 Merrimack St.,	IV.				
	F.	49 Pitts Street,	IV.	Aug. 6 to 29.	M.	City Hospital.	
	M.	237 Federal Street,	V.		F.	40 Webster Av.,	II.
	M.	396 Harrison Av.,	VII.		M.	525 Chelsea Street,	I.
	F.	10 Bennet Avenue,	II.		F.	1102 Tremont Street,	XIV.
May 14 to June 16, inclusive.	F.	54 Chadwick St.,	XIII.		F.	20 Seneca Street,	VII.
	F.	Prince Street,	II.		F.	59 Dove Street,	XII.
	M.	11 Malden Street,	X.		F.	70 Charter Street,	II.
	F.	7 Tremont Place,	XV.				
	F.	St. Ann's Inf. Assn.,	XII.	Aug. 29 to Sept. 26.	M.	42 Snowhill Street,	II.
	F.	4 Percival Street,	I.			Not stated.	
	F.	Forest Hill Av.,	XVI.		M.	243 Federal Street,	V.
	M.	5 Myrtle Place,	XIV.		M.	City Hospital.	
	F.	30 Allen Street,	III.				
	F.	1494 Washington St.,	XI.				
	M.	194 Prince Street,	II.				
	F.	374 Meridian Street,	I.	Sept. 26 to Oct. 28.	M.	70 Nashua Street,	III.
	F.	41 N. Margin St.,	II.		M.	1981 Washington St.,	XIV.
	F.	2 Vincent Court,	VIII.		F.	16 Simmons Street,	XV.
	F.	98 Revere Street,	VI.		F.	63 Albany Street,	VIII.
	M.	40 Union Park,	X.				
	M.	250 Harrison Av.,	VIII.				
	F.	111 Worcester St.,	XI.	Oct. 28 to Nov. 27.	M.	60 Cabot Street,	XV.
	F.	45 Warren Street,	XIII.		F.	8 Lothrop Place,	II.
		Not stated.					
	F.	74 Fifth Street,	VII.	Nov. 27 to Dec. 20.	M.	63 Athens Street,	VII.
	F.	21 Meander Street,	X.		F.	102 Portland Street,	IV.
	M.	183 Friend Street,	IV.		F.	7 Holden Place,	VI.
	M.	372 Hanover Street,	II.		F.	91 Chelsea Street,	I.

The percentage of Deaths in each Ward may be shown by the following Table.

Ward.	Population in 1870.	Deaths.	Ratio per thousand.	Ward.	Population in 1870.	Deaths.	Ratio per thousand.
XIII., . .	8,536	11	1.288+	XI., . . .	14,617	9	.616—
II., . .	24,912	27	1.083+	XII., . . .	19,880	12	.604—
IV., . .	10,216	11	1.077—	VI., . . .	11,792	7	.594—
XV., . .	14,851	14	.942+	V., . . .	14,166	5	.353—
X., . .	13,097	12	.916+	IX., . . .	14,142	3	.212+
XIV., . .	11,385	10	.878+	Deer Island, .	1,660	2	–
I., . .	23,824	20	.839+	City Hospital, .	–	9	–
VIII., . .	11,278	9	.798+	Mass. Genl. H.,	–	2	–
VII., . .	28,921	22	.761—	Not stated, .	–	8	–
XVI., . .	12,259	9	.734+				
III., . .	14,990	10	.666+	Total, . .	250,526	212	–

It may be proper to give in this connection the general locality and extent of the wards which, according to this table, have furnished the largest ratio of deaths per thousand of inhabitants, in order, as follows, viz.: *Ward XIII.*—By inspecting a recent map of the city, we shall see that this ward is situated in the south-easterly part of the old city proper, spreading out along the waters of the South Bay and intersected with tidal streams. It comprises the "Swett Street District," lies low, and has for the most part no proper drainage. The raising of a considerable portion of this territory is now being mooted by the city authorities. The contemplated route for the extension of East Chester Park to Dorchester nearly bisects this ward. *Ward II* comprises a segment of the North End, so called, the oldest part of the city; its semi-lunar outline bordering upon the Charles River and the harbor. Many portions of this ward have a densely crowded population. *Ward IV* is centrally situated, occupying very nearly a circle whose centre is in Scollay Square. It includes Portland Street, with the numerous courts and alleys adjacent, which can hardly be said to revel in favorable hygienic surroundings; eastward it reaches to the harbor and includes some of the most active business parts of the city. *Ward XV* is included in the extensive and sparsely settled district in the south-westerly part of the city. It lies low, and is in considerable part a marsh. It is largely intersected by tidal inlets. *Ward X* extends from

the South Bay, by which it is bounded for a considerable part of its extent on the east, to Warren Avenue and the Providence Railroad on the west. Washington Street, which formerly connected Boston with Roxbury as a narrow neck, passes through it lengthwise and nearly midway with made lands on either side. *Ward XIV* comprises the picturesque and elevated portion of the city—Roxbury Highlands, formerly so called—and extends in a somewhat narrow strip northerly as far as Tremont Street. *Ward I* comprises the whole of East Boston and the islands in the harbor, and is sometimes called the "Island Ward." *Ward VIII* is small in extent, stretching from the Common eastward to Ward VII. It is bounded by Albany Street on the east, and is intersected by Harrison Avenue, Washington and Tremont Streets.

Beginning now with those wards which are said to have furnished the least number of victims in proportion to their population:—*Ward IX* is situated between the Common and Public Garden and the remotest portions of the Back Bay lands in the one direction, and between Commonwealth Avenue and Ward X in the other. It is largely bottomed on made lands, but lately reclaimed from the sea, and comprises some of the finest streets of the city. It embraces also the recently raised Church Street District. The artificially made portion of this ward was originally a dry gravelly bank in Newton. *Ward V* extends from the Common eastward to the harbor, and includes the greater part of the *burnt district*, so called. *Ward VI* covers the more elevated part of the city north of the Common, extending thence along the Charles River to Brookline. *Ward XII* comprises the greater part of the peninsular of South Boston. *Ward XI* is similarly situated with Ward X, adjoining it upon the south. Chester Park, and Franklin and Blackstone Squares are in this ward. *Ward III* is bounded by Cambridge Street on the south, and extends along the borders of the Charles River as far as Warren Bridge. Most of the northern and eastern railway freight and passenger depots are in this ward.

It is not possible to predicate upon the meagre skeleton of facts here given, any positive opinion as to the conditions

which are most likely to give rise to the disease. This can only be done by a patient investigation of the premises in each individual case, and it offers an interesting field for future research.

Dr. S. L. Abbot has given a careful *résumé* of eleven cases which came under his observation. In three cases the hygienic conditions of residence were unknown; in three cases they were pronounced "good"; four cases occurred in narrow and crowded streets or courts; in one case the location was "as bad as could be,—low and damp, within fifty feet of the marsh on Parker Street, and quite near the large open sewer of that district; in addition to these appointments a cow-yard for the accommodation of a dozen cows adjoined the house on the east." In regard to one of the cases referred to above as living in a narrow and crowded street, he says: "A cess-pool in the yard had been full to overflowing for a year or more, and at full tide there was a foul stench in the house daily. The nuisance was rectified on complaint to the Board of Health, who discovered that the privy also overflowed into the drain. A case of cerebro-spinal meningitis was said to have occurred in the same house a few weeks previously." And of another case in the same category, he says: "The place is so shut in as to be wanting in good ventilation, and has stables for cart-horses in the rear."

Sixteen cases are reported, mostly in the months of March, April and May, from the Boston City Hospital, of which nine died and six recovered. Careful autopsies were made in five cases, showing the usual characteristic manifestations of congestion and effusion about the base of the brain and medulla oblongata, extending sometimes a considerable distance down the cord. No opinion is expressed as to the causation of the disease in these places.

Dr. Read furnishes the statistics of twelve cases which occurred in his private practice. This series of cases is especially interesting as presenting eleven recoveries and one death. Dr. Read attributes his great success to the administration of a combination of ergotine and extract of belladonna in proportion of one grain of the former to one-tenth of a grain of the latter for adults, which dose was administered every three or four hours during the acute stage of the dis-

ease, conjoined with other local and general remedies as symptoms seemed to demand. We understand that Dr. Read intends to give to the profession a *résumé* of all the cases which have come under his observation in which these remedies have been tried, and we therefore forbear to express any opinion on the subject here. Dr. R. makes a particular point of the irregularity of the heart's action in the diagnosis of this disease. In one case he speaks as follows : "The peculiarity most noticeable was the persistent irregularity of the pulse, kept up till after the patient became convalescent, and re-appearing on the least overexertion." Of another case he says : "The pulse was peculiar, consisting of one strong beat, then several feeble, ineffectual beats,—as if a clock should tick once and then the pendulum should swing several times without completing the ticks,—then go regularly for a while, and repeat the process indefinitely."

Dr. Ayer reports four cases, three of which were negroes. He says : "I consider the disease to be epidemic, and can form no conjecture as to its origin and cause."

Dr. Lyman says : "It is impossible, in my experience, to trace the disease to any supposed cause."

Dr. Morland, remarking upon the single case which came under his observation, says : "The previous health of the patient had been delicate ; she had suffered from a change of former better circumstances, had endured much care and anxiety, been indifferently nourished and irregular in the times of taking food ; she had a lodging-room at the top of the house, dry and well ventilated."

Two cases are reported by Dr. Fitz. Of one he says : "Patient lived in an old house ; the nature of soil such that thorough drainage might be questioned ; house not opened to sun and light." Of the other he says : "House recently remodelled, soil excellent, drainage good, plenty of sun and fresh air." Dr. Fifield reports three cases, about which he says : "They all lived in unhealthy localities, and the cause seemed to be exposure to cold and wet." Dr. J. Homans reports one case, of which he remarks : "The sanitary conditions of the locality showed nothing remarkable." Dr. Ellis reports a case, of which he says : "No assignable cause ; patient was healthy and living under the best hygienic con-

ditions." Dr. C. D. Homans says, of two cases reported by him: "One was a robust boy; the other an ambitious girl, but not robust, who had generally resided in the country. She had studied hard." Dr. Palmer reports three cases, in one of which he attributes the immediate cause to "anxiety in consequence of the sickness of her husband, and damp feet and clothing from exposure to snow." Dr. Fisher writes, under date of July 16, as follows: "The late epidemic was mild in comparison with the one I witnessed at Newbern, I think. Deaths, so far as I can learn, were less sudden and frequent, and the signs of disorganization of the blood less prominent." Dr. Gavin reports seven cases. "In none of those cases," he writes, "have I been able to detect a want of proper hygienic or sanitary conditions. The disease was singularly tedious in its course,—twelve or more weeks passing by with very little improvement in the symptoms. In only one of my cases did any eruption show itself, and then it was of the vesicular order." Two cases are reported by Dr. Swan. Of one he says: "Locality low, damp and filthy. Patient's mother is said to have died with similar symptoms, in the same house, four months previously." Dr. E. T. Williams presents a group of sixteen cases, which he regards as genuine specimens of the disease, and an analysis of which seems to him to favor the existence of contagion as a means of extension.

It will be seen that a considerable number of cases came under treatment in the hospitals, the origin of which, as is mostly the fact with severe diseases brought into hospital, could not be satisfactorily traced.

Braintree.—Dr. Torrey reports seven cases, five of which occurred in one family, all being children, varying in age from four months to eleven years. The locality is said to be damp and near a pond. "All these patients were of Irish descent, living in a low, damp place, their houses filthy, with nine or ten persons crowded into two rooms."

Brighton.—Of six cases reported, one, that of a stone-cutter, aged twenty-one years, "followed exhaustive labor at his trade during the very warm days of June." In another, "the surroundings were most unhealthy,—the patient being sick in the kitchen, on four chairs used as a bed." Another, a girl of eleven, was a close student, as well as a brilliant one."

Brookline.—Two cases reported. In one, "could be traced to no cause except exhausting work as book-keeper." In the other, "could be traced only to a crowded household, if that can be considered a cause." Dr. Salisbury has

detailed a single case, which manifestly falls into the category of the disease in question. He states, however, that he has had twelve or fifteen cases within a period of two months, varying in severity, and all going through their course without alarming symptoms, but with characteristics so similar in kind with the case he has reported, as to leave in his own mind no doubt as to their identity. In addition to these, three undoubted and fatal cases have occurred in his practice.

Cambridge.—Dr. Wellington speaks of the disease as occurring, for the most part, without premonitory symptoms, coming on suddenly with chills, vomiting, violent headache, soon followed with pain at the nuchæ and spine, etc., etc. He noticed in some of his cases a marked and sudden variation in the temperature of the surface, changing two or three degrees in the space of twenty-four hours or less, and that, for the most part, the temperature was from one to two degrees higher at night than in the morning. The pulse varied from 90 to 120. There was usually moisture rather than dryness of the skin, great sensitiveness to the touch, and marked exhaustion from the first. Stiffness of the muscles of the neck was common, opisthotonos not unusual. In a majority of his cases the decubitus was on the side. He notes a busy, talking delirium, the patient's mind running upon his occupations. This delirium was superficial, so to speak, the patient being easily roused to answer questions logically. He marked this peculiarity in even his worst cases. Dr. W. had noticed, during the spring months, that other diseases simulated the prevailing epidemic in their early symptoms. He had a case of acute rheumatism which began in this way. "I can say but little with regard to origin or supposed cause. In one case the surroundings were all favorable. In two cases the patients were in easy circumstances and, in the main, well provided for; but the cellars were damp and drainage was defective." In Dr. Webber's three cases, the locality was "low and dry, with a sandy soil," in one case; "low and damp in another;" "high and damp, with clayey soil, but excellent drainage," in the third. In six cases reported by Dr. Hildreth, it was "low and damp" in three cases; "moderately favorable" in the others. In Dr. Hooker's "twelve or fifteen cases" no origin or cause of the disease could be traced. The most aggravated cases were those living in healthy localities, patients cleanly, occupations light. In Dr. Massey's eleven cases, the ground was "low and underdrained" in six cases; filled land and badly drained in one case; healthy location in four cases.

Charlestown.—The epidemic was rife here during the early months of the year. Dr. Forster reports as follows: "In its attack the disease was sudden and severe, and attended with a large mortality. There was great variety in the modes of treatment adopted, as well as great uncertainty as to the result." He alludes to the existence of spurious or abortive cases of the disease,—cases having all the early symptoms of the genuine affection, oftentimes very marked, but lasting two or three days and then subsiding.

Chelsea.—Dr. Wheeler reports having observed many undoubted cases of the disease in his own practice and in that of his brother physicians. "The disease commonly came on suddenly with chills, severe headache and pain in the back, especially along the nuchæ, with sometimes symptoms of a violent cold, occasionally with vomiting, and almost invariably with great nervous excitement. There was generally great sensitiveness of the surface, restlessness and jactitation;—spots not constant, though frequently seen.

In most of the cases there was retraction of the cervical muscles, causing the head to be thrown backward." He had noticed in two or three cases an excessive tenderness of the posterior muscles of the legs and thighs, which preceded the retraction of the head and neck. He had seen one post-mortem examination, which showed extravasation of lymph about the base of the brain and spinal cord. He had remarked the existence of what he calls "spurious cases" of the disease in several instances, in his own practice and that of others, *i. e.*, instances where the patient was attacked suddenly and violently with chills, headache, pain in the back and joints, and great nervous disturbance, giving reason to fear the access of this disease—all symtoms, however, subsiding and merging, after a few days, into a somewhat slow convalescence and perfect recovery. He recalls two such instances in one family, a father and son, who were attacked about the same time with the symptoms above stated, conjoined with vomiting, feverishness, and severe pain in the head and back, and accompanied in each case with pain along the line of the fibula, giving promise of an attack of acute rheumatism. Both patients were confined to their bed, had distinct remissions every morning and exacerbations in the afternoon. After a period of from four to six days, such cases generally cleared up or resolved themselves into an attack of bronchitis, catarrh, or some other mild affection. At a later date he says: "The disease suddenly subsided as the dry weather of early summer came in. I think many of the cases were traceable to bad location, cesspools, privy-vaults of cellars poorly ventilated, or some deficient drainage about the premises."

Chicopee.—Dr. Abell makes the following statement: "From my observation of the cases which occurred in my own practice and elsewhere, I came to regard the disease as more like a rheumatic inflammation of the meninges of the brain and spinal envelope than anything else; that the proximate cause is atmospheric; that the exciting causes may be various, as a blow on the head, exposure to the sun's rays, cerebral excitement from fear, over-exertion at study, work, etc.; and I could not but think that the pestilential vapors arising from foul pools in the immediate vicinity of many of the cases had a decided influence." In another communication he writes as follows: "I have had some thirteen or fourteen cases of the disease. They all had many symptoms in common, while each had some peculiar to itself. Nearly all were children, between two and ten years of age. All occurred between the last of May and the fifteenth of June. The longest duration of the disease proper was from five to six weeks, the shortest three or four days. In all the cases where I was able to get at an intelligent history, the disease commenced with a decided rigor, or chilliness, followed by great heat of the head, with severe pain, particularly in the back of the head, with at first full and hard pulse, sometimes irregular, hurried and noticeably panting respiration, pain and stiffness in the muscles of the back of the neck, with retraction of the head, in some cases almost to a right angle with the body, accompanied with extraordinary rigidity. Nearly all the cases had pains in the joints, either of the knees, elbows or ankles, usually of an intermittent character. Nearly all had distinct remissions or relapses. The temperature did not exceed 100° in the axilla." "Several of the children had been exposed bareheaded to the rays of the sun not long before the attack. Three had met with a fall within the preceding forty-eight hours. Two were taken down at school, where their brains had evidently been much exercised by study and religious catechizing,—as they were continu-

ally conning over their lessons in their delirium, and seemed terribly afraid the priest would punish them. Five cases occurred in the immediate neighborhood of a pool of standing water, the refuse of several blocks of houses crowded with Irish tenants." In conclusion, Dr. Abell records the following interesting fact: "During the past year, several cases of the head affection among small children, which occurs in connection with dentition usually, have proved fatal after a prolonged coma and, often, convulsions,—which a post-mortem examination showed to be pure cerebro-spinal meningitis,—*i. e.*, the brain itself seemed normal, but the membranes were congested and more or less inflamed, and suppuration, to a greater or less extent, had taken place. These children died with symptoms often ascribed to hydrocephalus, but no serum was found."

Dedham.—Of three cases reported by Dr. Maynard, "No palpable cause. The locality was in all the cases good." Of four cases sent by other physicians of that town it is remarked: "All these cases seemed to arise from overheating, followed by exposure when the patients were fatigued to exhaustion."

Everett.—Dr. Wakefield says of the four cases he sends from this town: "My cases seemed to depend upon over mental and physical exertion, though in all these cases the land where the patient resided was low, marshy and damp."

Fall River.—Dr. Eddy, who reports six cases, says: "I have observed nothing worthy of special remark in regard to the home surroundings, drainage, water, etc., unless it be that their condition has been exceptionably good."

Fitchburg.—Dr. Hitchcock says: "My belief is, from professional observation and inquiry, that stiff neck, muscular lameness and soreness, headache and backache, were more frequent accompaniments or concomitants of both zymotic and climatic diseases in this city last winter and spring than usual."

Great Barrington.—Dr. Foster says, in connection with the single case which came under his care (a girl of fourteen years): "There was no cellar under that part of the house occupied by the patient; the house itself was damp; surroundings not good; privy too near; drinking-water obtained from a well near by. The patient had been closely confined to school."

Hadley.—Dr. Bigelow, referring to a case occurring in his practice, writes: "The home of this patient is on the bank of the Connecticut River, along the eastern side of which, in the town of Hadley, most diseases have, for several years, shown the influence of some epidemic depressing power. Soil, a sandy loam. Hygienic conditions good, except that the sink might possibly be considered in bad order for hot weather." Dr. Bonney writes, Dec. 8, as follows: "The disease has not presented itself to any extent in anything that could be called an epidemic form; indeed, there has been less of meningeal form of disease this year than usual. For the last ten or twelve years I have had to contend with secondary forms of the disease. If the system of the patient got lowered to any extent this condition has frequently been developed. This has been in past years so frequent, that one's anxieties were greatly increased respecting the termination of what might seem to be mild disease. The accession would be sudden, and either rapidly fatal or there would be a

lingering convalescence with great prostration. In 1863 diphtheria was very prevalent in this town, and its accession was very violent. It was attended with considerable fatality. Ever since that date there has been more of the meningeal difficulty. I cannot disabuse myself of the inference, that the proximity of diphtheria frequently is the indication of the origin of the brain disease,—*i. e.*, that the poison which produces the former may also allow of the development of the latter. I have also thought that typhoid fever stood sometimes in essentially the same relation."

Haverhill.—In six cases reported by Dr. Cheney, the locality is stated to be either "low or damp" or "low and damp" in all. In one case the patient was a shoe-fitter, and had worked in a damp shop, and his house was situated in a swampy locality, on new-made land, with damp cellar and poor drainage,—"all which circumstances combined promoted the disease." Of another case he writes: "Patient's house in a damp locality,—being a tenement over a shop where shoe-stock is prepared, from which a constant dampness rises and fills the rooms above; drainage imperfect; the air filled with impurity from surrounding buildings." Of another (a child) he says: "She had been permitted to play outside the house in April, sitting on the ground; the soil wet; drainage poor; cellar damp." Of the next he says: "Patient lives near the river, in the midst of a foreign population; cellar damp; drainage poor." And of the remaining two cases: "They lived in a damp, undrained locality; no sewerage; cellar damp; air and water impure." Dr. Fernald, in reporting a single case which came under his observation, says, "The locality is near a lake, where typhoid fever prevails when the pond is low. There are twelve or fifteen families in this locality, and two years ago there were measles and typhoid fever in every household." Dr. Crowell reports three cases, in two of which "the soil was clayey, and the cellars damp; in one, high and sandy."

Hingham.—In two cases reported the locality was "high, but near a sluggish tidal stream."

Holyoke.—Of the five cases reported, Dr. Hummiston writes as follows: "The surroundings, in a majority of instances, were such as to invite typhoid fever. In fact, it had prevailed to a considerable extent in the same locality only a few weeks before; and while I was attending upon case 1, in this series, it was alleged a patient died of typhoid fever in the same square. No. 2 occurred in the same section of the city. But the characteristic marks were the same in all. What should cause them, however, is as much a puzzle to me as to any one else who has sought for the origin of this terrible disease."

Lancaster.—Dr. Thompson writes: "Have seen no well-marked case of this disease in this vicinity, but still have observed a peculiar influence in other diseases,—more pain in back of head and upper spine than usual, not very marked or lasting, yet sufficiently prominent to be noted."

Lawrence.—Dr. Chamberlain confirms the fact, so often stated, of the disposition on the part of physicians and others to exaggerate the extent of the disease by including in its category very mild cases resembling it in some of their features, but passing off spontaneously in a short time and without treatment,—showing, as we have stated elsewhere, the existence of an epidemic influence which gave a coloring, so to speak, of cerebro-spinal symptoms in divers insignificant ailments. "There have been many cases of pain," he says, "often severe, in the head and neck, with little and, in some

instances, no constitutional derangement, which, I have no doubt, were the result of the specific influence which caused the cerebro-spinal disease."

"I am unable," he continues, "to say anything satisfactory in regard to origin or cause. It did not appear to depend, either for its remote or exciting causes, upon any influences arising from locality,—although a few cases were developed amidst surroundings which more than suggested that the vitiated air of ill-ventilated houses was instrumental in determining the disease."

Leverett.—Of a single case reported, Dr. Fish writes: "No appreciable cause; soil a gravelly loam; cellar dry and clean; sink and spring well cared for; drinking-water excellent."

Leominster.—A comparatively large number of cases have been reported from this town. Dr. Pierce, who gives the data of twenty cases, writes, in regard to the disease: "It seemed to be rather dependent upon epidemic influences than upon any local cause,—most of my patients having their houses on a light gravelly or sandy soil, with no fault of drainage, so far as I could ascertain. In some cases several members of the same household had the disease." He further says: "It seemed to select neighborhoods for its centres, thereby, indeed, indicating a local cause, yet what I could not satisfactorily ascertain. The patients were mostly healthy, robust, laboring people, in easy circumstances." Nearly all of these cases recovered; in regard to which, Dr. P. writes: "This unusual result is, I think, due more to the mildness of the attack than to the special mode of treatment." He further says: "A singular fact connected with these cases is this,—they were all Americans, with one exception, and that one was native-born, though we have a large percentage of foreign population." Dr. Field, who reports four cases, writes of one of these cases as follows: "The locality was low and damp. I consider the proximate cause to have been sleeping on the ground after a hard day's work; and among the remote causes may be named a life of hard work and gradually diminishing pecuniary means. Perhaps the water used by the family, taken from a neighboring pond, may have had something to do in causing the disease." He further reports, under date of Nov. 1, that, within a few weeks, he has seen and examined several supposed cases of the disease in patients who had the attack months ago and were not yet fully recovered. "We know," he adds, "that in all epidemics a good many forms of disease will, in a greater or less degree, simulate the epidemical affection and still not be genuine." And he presumes that some of the cases which came under his observation, in his own and others' practice, may have been of this character.

Lowell.—Under date of August 30, 1873, Dr. Nickerson writes as follows: "Nineteen out of thirty physicians consulted have had cases of the disease. Five others, not consulted, have recorded deaths." * * * "The epidemic has not been confined to any particular quarter of the city, but has been generally most severe in the more thickly settled parts of the town. The heights of the city, *e. g.*, Dracut Heights, Belvidere and the higher portion of Chapel Hill, have furnished but very few cases and only two deaths." * * * "The attack was almost always sudden, and, when sudden, began with headache and vomiting and prostration." Among the symptoms he enumerates headache as existing in every case, generally of a peculiarly intense character, delirium, tenderness over the spine, retraction of the head in a vast majority of cases, opisthotonos only occasionally, tonic and clonic convulsions of local

muscles not uncommonly, petechiæ in a few instances, hyperæsthesia of the skin in a goodly number of cases, a variable pulse, accelerated respiration, restlessness and jactitation. In regard to the severity of the present epidemic, he says: "On the whole, I should think that the epidemic had been a mild one." On the subject of causation he continues as follows: "After careful inquiry I get no light as to the cause of the disease. As in most of the epidemics in this country of which I have any knowledge, a majority of the cases occurred in the period between December and July; there were only a few scattering cases after that time. The only circumstance that has pointed to contagion was the occurrence of two fatal cases in one house, two sisters being attacked within two weeks of each other. While on the subject of causation it may be well to say that our system of sewerage is quite defective, and that the recent introduction of city water renders it relatively more so, though improvements are now in progress in this direction." "In comparing the rainfall and temperature of the epidemic season of this year with those of the same period in previous years I find nothing worthy of remark."

Under date of December 19, he writes: "Out of thirty-seven deaths from this disease, twenty-seven occurred between February and the last of July. Since August 1st, there has been a material decline in the number of cases." * * * "As to the matter of location: I thought of water-courses and damp soil in my earlier perambulations, but could not establish any law in this particular. Out of forty-eight cases which I have recently examined I find that only sixteen can be fairly placed in damp regions or in the line of water-courses."

Lynn.—Dr. Webster gives a detailed account of the character and habits of the epidemic as observed by him in Lynn, where the disease prevailed quite extensively. The attack, as a general rule, came on suddenly with severe headache, especially posteriorly, pain soon extending to the neck and back. Vomiting was oftentimes an early symptom. Retraction of the head was a common occurrence. All ages were attacked. Dr. W. likewise refers to the prevalence of spurious cases, so called, where the patients had the early symptoms of cerebro-spinal meningitis, but which, in three or four days, recovered or lapsed into some other and milder affection. The first death resulting from this disease which appeared upon the records at the city hall in Lynn dates back to March. Dr. W. thinks a few patients were attacked as early as February. He gives the record of four cases which occurred in his practice, in two of which the locality is stated to have been "dry" and in two "low and undrained." Both of the former were on the borders of a lake, where also several other cases occurred. In regard to the two last named of his cases the sanitary conditions are stated to have been exceedingly poor. Dr. Cahill says, of four cases reported by him, that the locality was "low or damp" in three and "fair" in one. Dr. Galloupe says, of nine cases which he reports: "I have been unable to find any cause, proximate or remote. The disease has appeared under every variety of condition, among old and young, rich and poor." Three out of five cases reported by Dr. Drew are supposed to have had for their proximate cause "over-exertion." Dr. Goodell says, of three out of seven cases reported by him, that the locality was near a pond. In one other, the sanitary conditions were "very poor," in the rest, "fair." Dr. Newhall, who reports six cases, writes: "In no instance could I discover any cause, either in the locality or condition of the patient, which could in any manner predispose

to the disease." Out of four cases reported by Dr. Kilham, the locality in three was "low and damp."

Manchester.—Dr. Priest reports no cases, but says that he has had several which seemed to simulate the disease, with pain on the back of the head and neck and muscular contractions.

Marblehead.—Dr. Eveleth reports four cases, and refers to "an impure atmosphere, especially in a damp district," as, in his opinion, a cause of the disease. Dr. Neilson, who gives four cases, reports the locality to have been "low and dry" in two, "low and damp" in one, and in one, "high and dry."

Methuen.—Dr. Chamberlain reports a single case, of which he says: "The patient lived in a tenement boarding-house, on a dry soil, but close upon a bank bordering a sluggish stream. The house was crowded and the air impure."

Millbury.—Dr. Lincoln gives the details of five cases, of which he says: "I know of no cause other than epidemic influence. In 1872, there were some fifteen or twenty cases of the disease in this town, and then a much larger per cent. were fatal."

Milford.—Dr. Barns gives the details of nine cases which came under his care. In regard to them he says: "Nearly all the cases which have come under my care the present year, and in previous ones, have been those whose physical and mental powers had been more or less overtaxed or whose general health had been somewhat impaired by some previous disease. This being the fact the question with me is, Is this one of the causes of the disease, and is the tendency to it transmissible?

New Bedford.—Dr. Prescott sends the details of a single case, in regard to which he says: "The house was situated on low made land. Walls of bedroom constantly moist; no cellar; privy in rear, and drainage flowing from the house."

North Bridgewater.—Dr. Borden gives the details of four cases which occurred in his practice. He can find no special cause for the disease. The locality was damp in one, low and damp in one, and good in two cases.

Northampton.—Dr. Fiske reports that eight cases had "come under his observation at some stage of their progress. Of these, six were American, two were of Irish parentage; three were adults, five were children; seven were of the female, one of the male sex. Six recovered and two died."

North Adams.—Dr. Babbitt, in a recent communication, writes as follows: "In the spring of 1871, cases of cerebral meningitis were by no means infrequent in this locality. They were of a marked character and plainly diagnosed,—continuing with decreasing severity till autumn." * * * "What I would especially remark is, that since that period we have had no distinct typhoid fever. I have been in this locality more than twenty-five years, and have never passed an autumn without cases of typhoid fever till the seasons of 1872 and 1873; since which I have had no well-marked case of that disease.

"Pharyngitis, pneumonia and other febrile diseases have, in almost every instance, taken on cerebro-spinal symptoms; and it is common for the patient to say, if his head is raised for any purpose,—'you hurt my neck!'—so that it is difficult to tell which is the disease,—the pneumonia, etc., or the cerebro-spinal meningitis. This general observation has struck me forcibly iu connection with disease in this locality."

Palmer.—Dr. Holbrook had a single case about which he says, "Water and drainage good; no traceable cause of the disease."

Peabody.—Three cases are reported. In one—"the location is a level area of ground, nearly circular and surrounded by hills and farms,—a sort of amphitheatre, as it were, perhaps three-fourths of a mile in diameter: the soil, dry. Not far from the house a field is used for the purpose of drying glue-stock, and from this the smell is sometimes very offensive. The drains of the house were in a slovenly condition, discharging within fifteen feet of the well." In the second, the house stands "on low made land; a tannery on one side and a morocco manufactory on the other. The smell is offensive, and the air must be very impure." The third was in a healthy locality. The patient (a young woman) "had been at work at Lynn for some time, at a shoe establishment, using a sewing-machine and confining herself very closely, working, at times, sixteen hours a day; she had been for years subject to bilious attacks."

Quincy Point.—A single case. The house of the patient "stands on a low, porous soil, and within an eighth of a mile of tide-water. His sleeping-room is large and well ventilated; cellar, dry; sink empties into the privy, which is about a foot from the house. Half a dozen other persons live there, and are all in good health."

Roxbury Highlands.—Dr. Flint gives a report of two cases, of which he says: "I cannot think either case referable to bad drainage or impure water. The first was in St. James Street; drainage, good; water, Cochituate. The second was at the Simmons estate, Highland Street, with which locality Dr. Derby is probably familiar. The water, I presume, is well-water. I made no inquiries in regard to drainage." Dr. Streeter also reports two cases which he could not trace to any special cause. He had also "seen many cases accompanied with cephalalgia and rachialgia, requiring a few days' release from business; no special treatment; others did not give up business or occupation. Evidently a strong epidemic influence prevailed throughout the winter and spring."

Salem.—Dr. Johnson writes: "We have not seen much of cerebro-spinal meningitis in Salem. There have come under my own observation several cases of intense and uncontrollable headache, affecting chiefly the back of the head, with muscular pains and slight stiffness of the neck, suggesting for several days the commencement of an attack of cerebro-spinal meningitis. But, without further development of symptoms, the pains would slowly decline and cease. These cases seemed to me peculiar, and in conversation with Dr. Kemble, I found he had met with several cases in which there seemed to be but little lacking to constitute the initial symptoms of the disease. The quiet departure of the symptoms suggested to me an abortive cerebro-spinal meningitis; yet, the cases were too ill-defined to be satisfactorily classified. Of the few genuine cases which have occurred, the locali-

ties have not been peculiarly damp, some of these cases occurring in the drier portions of our city."

In a letter of later date, Dr. J. gives an account of a large number of typhoid fever cases, which occurred during the summer and autumn, and sketches the localities in which this disease especially prevailed. Bad air and water, insufficient drainage and unsanitary surroundings made up, as usual, the prevailing elements attendant upon the advent of the fever. But cerebro-spinal meningitis did not, as we have seen, particularly flourish in these localities, although the predisposing cause was imminent during the earlier part of the year.

Sandwich.—One case reported: "Can give no cause; the locality is at least thirty feet in altitude above sea-level; plenty of air and light; no miasm."

Somerville.—Of six cases reported, the locality in five was found to be "low and damp." Dr. Knight gave the details of two cases only, though he "had seen many more." "Locality," he says, "seems to have had no marked influence. In none of my cases can I refer to any origin or cause."

Springfield.—Twelve cases are reported. The locality was "low," or "low and damp," in nine cases, "damp" in one, "high" in two.

Stoughton.—Dr. Tucker reports seven cases, and says, "I could not discover that locality, whether high or low, damp or dry, had any influence."

Swampscott.—Dr. Chase says of a case reported by him: "He was as healthy a young man as we have in town, of good habits, etc. I know of no cause why he was attacked with this disease."

Tyngsborough.—Dr. Dutton had two cases, "five miles apart." Of one of them he says, "Her earliest symptoms date sharply from exposure in a damp night, with wet feet."

Ware.—Dr. Miner says: "I have neither seen nor heard of any cases of cerebro-spinal meningitis in this region. We have had a few cases in which there were complaints of pain in the neck and back, but not sufficiently severe for treatment, or to warrant us in calling it the genuine disease, though there was evidently a tendency that way."

Watertown.—Dr. Hosmer relates the following somewhat curious circumstance in regard to three cases of the disease which came under his observation, the patients being two brothers and a sister: "Their home was in the village of Watertown, in the second story of a house with fair surroundings. The eldest (a boy), fifteen years of age, was living on a farm two miles away, visiting his family every Sunday. He was seized with the disease, while away from home, at the same time that his brother and sister were ill with it at his father's house."

Webster.—Dr. Brown gives five cases. He says: "I am unable to state any specific cause for the occurrence of the cases aside from the supposed epidemic influences, as the circumstances of these patients, with the exception of two which occurred in same family, were very unlike in almost every particular; and I saw no especial reason for the attack."

West Roxbury.—In three cases reported by Dr. Maynard, he finds "no apparent cause."

Weymouth.—Dr. Forsaith reports a single case, which, he says, occurred in the vicinity of other families and among a healthy population.

Williamstown.—Dr. Smith writes, in regard to his experience in this disease, as follows: "I have not been able to discover the cause; I once attributed it to the water; and my conviction now is, that to that source, combined with local causes, as previously set forth, is to be ascribed the disease."

Winchendon.—Dr. Ira Russell states that six cases of cerebro-spinal meningitis had come under his observation and treatment during the past summer. He also states that he had been familiar with the disease in the winter of 1863–64, during his army life. He says the disease was "almost invariably ushered in by a chill, great prostration, nausea, vomiting, severe pain in the head, neck and back, delirium, sometimes wild, but more commonly moderate, the patient being easily roused to answer questions, but immediately relapsing into his former condition, with contraction of the muscles of the neck and back, rigidity of the extremities and great restlessness. Deglutition was commonly difficult, often impossible. The patient would commonly remain in this condition from twelve to thirty-six hours, when re-action would come on, followed by fever, usually of a typhoid type, lasting from one to six weeks, sometimes ending in recovery, oftener in death." In regard to causation, he believes the disease to be undoubtedly due to an epidemic influence, "an influence more nearly allied to that which produces influenza, peritonitis and pneumonia rather than to the idiopathic fevers, like typhus and typhoid."

Winchester.—Dr. Winsor could find "no assignable cause" for the few cases which came under his observation.

Woburn.—Dr. Cutter reports four cases. In two the locality was "unfavorable"; in two it was "fair." Dr. C. says: "It is my opinion that cases of cerebro-spinal meningitis occur in Massachusetts, which, from their mildness, are sometimes overlooked and mistaken. There is a mild form of the disease which may be thought rheumatic."

Worcester.—Twelve cases are reported. Of these Dr. Clark reports seven, and says that three cases occurred in one family and two in another. Of the former group he says: "The house is in a generally healthy location; it stands, however, upon a bank, sloping towards the street, so that the land in the rear is considerably higher than the front. Two families occupy the house. The sink-drains open at the side of the L part, and the drainage flows in a superficial gutter, by its side, to the front, and from thence, under the sidewalk, into the street sewer. The well is outside and a little below where the sink-spout debouches." Of the latter group he remarks: "The location of the street is high, upon a hill sloping to the north; soil wet, with hard-pan beneath; hygienic surroundings very unfavorable." Dr. Clark states that there were fifteen cases in that city, and one in Millbury, in the seven months from December, 1871, to July, 1872, inclusive."

Having thus quoted largely from the correspondence of medical gentlemen, in various parts of the State, as to the locality and other circumstances connected with the origin of

the disease, I will add the results of my own personal investigation in several towns and cities where the epidemic has more extensively prevailed.

Charlestown.—In company with Dr. Forster, I personally inspected the following localities :—

Case I. *A child, 24 Henley Place.*—One in a row of tenement-houses, each floor of which is usually occupied by two families. The living-rooms were, in this case, on the second story, back, and consisted of a kitchen and sleeping-room, the latter about 7×10 feet in dimensions, opening out from the kitchen, and having one small window looking into the back yard. These houses were on made land. Cellar in fair condition.

Case II. *Adult male, 108 Water St.*—Old house, near the navy-yard gate. Kitchen opens out upon the back yard. Sleeping-room of the patient 12×14 feet, without windows. Back yard filthy; privy-vault full and overflowing. Tide-water flows at times into cellar. No drainage.

Case III. *A child, 12 Thorndike St.*—A few rods from mill-pond,—the receptacle of Miller's River; land low; no drainage; privy in back yard. Water flows into the cellar. Contents of two sinks empty upon the ground cellar-floor. Family recently from Devonshire, England, and much disgusted with their present home. Much complaint of the bad air coming up the stairway from cellar.

Case IV. *Adult female, 41 Chestnut Street.*—A cheerful and pleasant street; high and dry; sanitary conditions apparently all right; cellar said to be dry and drainage good. I learned that this patient, the day before her attack, attended a funeral, went down into the vault, where she remained some minutes,—that the tomb was cold and damp, and she felt chilly while there.

Case V. *A child, 39 Henley Street.*—On low ground; floor of cellar covered with boards, partially decayed; house drain said to be connected with the street sewer.

Case VI. *Adult female, 44 Henley Street.*—Tenement-house; surroundings poor, but not of the worst; living-rooms a kitchen and bedroom adjoining, on ground floor, back; bedroom small, immediately over cellar, which is not wet, but in a slipshod state generally; bad smells complained of.

Case VII. *Adult male, Allston Street.*—A pleasant, cheerful-looking street; locality high and dry. This man worked in a furniture factory on "the point," so called, close to the water.

Case VIII. *Adult male, Mount Vernon Street.*—Locality apparently dry and pleasant. This man was a rigger, and employed much about ships and docks.

In addition to the above localities, which were personally visited, the exact position of a great many other cases which occurred in this city was obtained by our medical correspondent and marked down upon a map. They were in the main low and damp, were mostly upon made land and near the water, with marked exceptions, however, as in the list above given. On consulting this map, I find the locality of 49 cases thus designated.

Chelsea.—The following places in which the disease had occurred were visited in company with Dr. Wheeler:—

Case I. *A child, Williams Street.*—A double house. The locality of the street itself is good. The foundation of the house, however, is four feet below the level of the street, with kitchen and cellar on the same level, *i. e.*, a basement kitchen, where the family principally live. Drains connected with the main sewer, but were without traps. This house has been complained of to the authorities for its unsanitary condition. Dr. W. says he never knew a family to live there six months without cases of illness or death. Since the occurrence of the present disease the drains have been repaired and a trap affixed.

Cases II and III. *Marginal Street.*—Two cases occurred here,—one a child, the other an adult male. The house backs immediately upon the water, and is too low to allow of drainage. The living-rooms are on the ground floor, and consist of a kitchen and sleeping-room.

Case IV. *A child, Middlesex Street, lower end.*—Living-rooms on a level with street; basement or cellar falls off in rear, which is used as a cow-yard, and is foul and filthy; surroundings also bad. A pool of stagnant water stands within two or three rods of the house.

Case V. *A child, Maverick Street.*—Living-room on first floor, level with the street, with basement or cellar falling off in rear. In this basement was a bar-room where liquors were sold. A foul smell noticeable; land low, about one hundred yards from the water; drain said to enter the street sewer.

Case VI. *A child, Maverick Street.*—House small; situation low; surroundings bad; cow-yard twelve or fourteen feet from the house, foul and in bad condition; no cellar; no drainage possible.

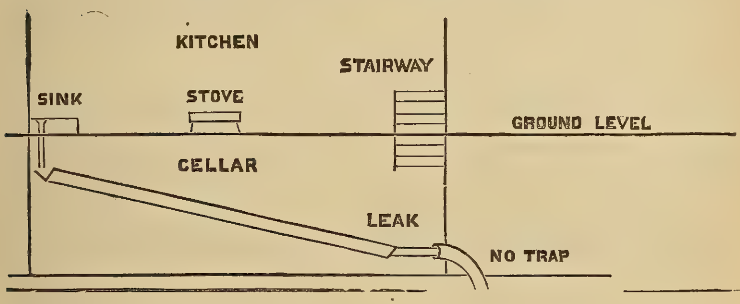
Case VII. *A child, Central Avenue.*—The house was shut and the family absent. Surroundings apparently good. Could learn nothing definite about the drainage.

Case VIII. *Adult male, corner of Central Avenue and Lynn Street.*—Locality good; ground rather high; house new; surroundings apparently good. Did not enter and inspect the premises for domestic reasons.

Case IX. *Adult male, Middlesex Street.*—To a casual observer this house would seem to be well situated, with fair surroundings; but on examining the premises it appeared there was a cellar, perhaps twelve or fourteen feet square, under the rear of the house, directly beneath the kitchen. The drainage from the sink of said kitchen passed into an open, V-shaped wooden trough, and was thence conveyed across

the cellar to the opening of a pipe three or four inches in diameter, not trapped, which conducts presumably to the street sewer. At the junction of the trough with this pipe the connection was so loose that the greater portion of the slops emptied directly upon the cellar floor, which was of boards laid upon the ground. A foul, strong and constant stench pervaded the cellar, which had no connection with the outer world other than by means of the stairway and door through the kitchen. It was stated that this patient was in the habit of rising early (4 to 5 A. M.), making a rousing fire in the kitchen, and there reading his paper, etc., till he went to his work. To make clear the description above given, a diagram of these premises is subjoined.

SECTION OF KITCHEN AND CELLAR CASE IX



Case X. *A child, Pratt's Block, off Second Street.*—This is in a row of wooden houses, of a mean class, in dilapidated condition, without cellars, and having their ground floor four feet below the level of the street; living-rooms on ground floor, comprising kitchen and sleeping-room, of eight-feet stud, dark and ill-ventilated; sink foul, its contents emptying directly upon the ground, A marsh comes up to within a few rods of the house. Yard uncleanly; the whole place redolent of bad smells.

Case XI. *A child, Auburn Street.*—House old, dilapidated; basement-cellar flooded at times, and always foul and damp; no drainage. Twenty feet from house is a large pond of greenish water, into which flows the refuse from the Chelsea Laundry. A great mortality of children from cholera-infan-

tum and like diseases is reported in this locality in the hot months.

I have given on a previous page the report of Dr. Wheeler, in which he states that all, or nearly all, the cases which have come to his knowledge, have occurred on the low, marginal lands, where the soil is to a greater or less extent saturated with moisture. "The same localities," he says, "where they usually expect to find the majority of their cases in epidemics of typhoid, diarrhœa, etc."

Cambridge.—Accompanied by Dr. Wellington, I inspected the locality of such cases as he had been cognizant of in that city.

Case I. *A child, Somerset Street.*—Surroundings bad; land low and marshy; water at high tide comes up very near the house; no cellar; no drainage.

Case II. *Adult male, Webster Street.*—House on a dry and sandy soil; surroundings fair; in the yard is a cesspool not connected with the street sewer. This patient was employed in a druggist's store, under the Revere House, in Boston, and was seized suddenly while about his work and taken home for treatment.

Case III. *Adult male.*—House in near vicinity of the marsh; living-rooms on the ground floor; kitchen immediately over a cellar which is very damp and foul. The patient was an old man, and spent much of his time in this kitchen. The house had been much complained of for its bad smells. Quite recently the house drain had been connected with the street sewer.

Case IV. *River Street.*—Locality apparently all right. Premises not entered, but Dr. Wellington reports that to his knowledge no sanitary defects exist.

Case V. *A child.*—Locality, an Irish settlement on low land; a sort of hollow in which water collects after rain; no cellar; surroundings poor.

Case VI. *Adult, Bigelow Street.*—High and dry; drainage good; to outside appearances everything all right; premises not entered.

Case VII. *A child, Austin Street.*—Soil dry; drainage good; at very high tides water backs up and enters the cellar; this has not happened the last year.

Case VIII. *A child, ——— Street.*—Situation of house low; water comes into the cellar in winter and spring after rains and thaws; the occupants think it was more than usually wet last season; cellar floor covered with boards partly decayed.

Case IX. *A child, Tremont Street.*—House one story; surroundings bad; no drainage; large pool of stagnant water about two rods distant.

Case X. *A child, Cambridge Street.*—Land is low in rear; water from the sink empties into back yard direct; no drainage; cellar said to be dry.

Case XI. *A child, Rideout Street.*—An Irish settlement; land low; soil heavy; stagnant water in immediate vicinity; no cellar; no drainage.

Case XII. *A child, Cambridge Street.*—Surroundings poor; tide-water comes into the cellar at times.

Case XIII. *A child, Cambridge Street.*—Locality somewhat low; living-rooms on second floor; surroundings fair.

Haverhill.—Dr. Crowell made with me a tour of inspection covering the undoubted cases which had come within his knowledge.

Case I. *Young man, Spring Court.*—This case occurred in a row of tenement-houses of a good class, newly built, standing on rising ground, with good chance for drainage. Soil heavy; cellar damp, the water percolating through the walls

from the higher grounds beyond, and at times standing upon the floor of the cellar. At the time of our visit the moisture had been absorbed by a layer of gravel put upon the floor for this purpose; general aspect of the house cheerful and pleasant.

Case II. *Adult male, Spring Place.*—Kitchen and cellar in basement, the floor of which is a little below the general surface. An exceedingly offensive odor exhales from the sink-opening, filling the kitchen with a sickening stench. This kitchen connects by a stairway with the sitting-room where the patient had been accustomed to pass his evenings. Adjoining privies and sink-drains likewise in bad condition.

Case III. *Adult male.*—House of average quality, with cellar-kitchen; no noticeable odor about the house itself; cellar close and ill-ventilated; apparently not damp. A stable adjoins the house in rear, on land a little higher, the drainage from which must by gravity tend towards, if not enter, the cellar; privy of an adjoining house overflowing and producing an offensive odor.

Case IV. *A child, Mount Washington.*—House about one hundred and fifty feet above the river, and some fifty rods distant; apparently dry and sandy surface; family lived in second story; there was a cistern in the cellar; the cellar itself in fair condition.

Case V. *A child.*—Locality about a mile from the town, elevated two hundred and fifty feet above the river; soil rich and loamy, with clayey substratum; cellar very damp a great part of the time, water standing there sometimes to the depth of two inches or more. The family have sometimes fancied they perceived a foul odor and damp air coming up from the cellar, through the register-openings, into their sleeping-rooms; a bad smell from the privy, in close vicinity to the kitchen complained of.

Case VI. *A child, rear of Primrose Street.*—A crowded colony, of French mostly; surroundings bad; soil clayey; water stands after a rain; no drainage.

Case VII. *Chestnut Street, off Water Street.*—House on a declivity, perhaps forty feet above the river, and twenty rods from its northern bank; surroundings good; the water, however, from the higher ground flows into the cellar, making it wet and foul, and often necessary to "put down boards"; had been very wet and damp just before patient was attacked; there was a disused well in the cellar, and an offensive odor in the sitting-room immediately over it; the drainage from the sink is carried into the garden a few feet from the house.

Case VIII. *Adult female, Green Street.*—House appeared all right; cellar a trifle damp, but not wet; the flowage from the sink of the next house above is seen upon the surface about ten or twelve feet distant, and has been "complained of."

Case IX. *Adult female, Auburn Street.*—House small; soil clayey and damp; no drainage; cellar very damp; two or three inches of water stands there, the exit of which has become stopped up; an offensive smell comes up the cellar stairway into the sitting-room immediately above; sink empties into a hogshead set in the ground.

Case X. *A child, in "Portland Extension."*—House stands high; cellar in fair condition; the locality of this house is good; the sink-drainage stands where it is poured out, quite near the house; but on the whole the hygienic conditions are favorable.

Lynn.—In company with Dr. Webster, I visited and examined the localities and habitations where a majority of the well-authenticated cases of the disease had occurred.

Case I. *Oxford Street, between Willow and Almont, right side.*—Land low; surroundings poor.

Case II, *A child, Willow Street, between Oxford and Liberty, left side.*—The family occupied the upper story of an old house; shop underneath; land low; surroundings bad; the surface bestrewed with manure and garbage; a pool of stagnant water near.

Case III. *Central Street, north side, near City Hall.*— House surroundings fair.

Case IV. *A child, C Street, water side, in near vicinity of lumber yards* — This street skirts the harbor, is muddy, almost impassable in spring; soil saturated with moisture.

Case V. *Adult male, Pleasant Street, foot of Harbor Street.* —Soil low and damp; surroundings bad; cellar always wet. The tide-water backs up through the drain, standing sometimes a foot or more in depth; sink empties into back yard direct; a pool of stagnant water near. There has been much sickness in this house during the past year, typhoid fever or rheumatism being almost constantly present.

Case VI. *A child, on the same street, and near the above.*— House similarly situated; cellar damp and uncleanly; apparently no drainage; bad smells.

Case VII. *A child, Tyrrell's Block, on Pleasant Street.*— This block consists of several rows of wooden houses, all of the same build. The street, in this part, is "very muddy, and difficult to drive through in spring." Land low; surface-water runs readily into the cellar. It has water supplied from the water-works, and each tenement is furnished with a water-closet in the cellar. I learn that a fatal case of the disease occurred in this block six months previously.

Case VIII. *A child, Bond Street, west side.*—General situation and construction of tenement similar to that in preceding case. Land low, but the soil drier; cellar damp; surface-water sometimes flows into it.

Case IX. *A child, Church Street, south side, quite near Lynn common.*—Land somewhat low, but not damp; surroundings good; aspect of house and street cheerful and pleasant; no sanitary defects.

Case X. *A child, Emerson Street, west side.*—Land low and flat; it is, however, dry and pleasant. Sanitary surroundings good; cellar in fair condition.

Case XI. *North Common Street, north side.*—Surroundings good; premises not examined.

Case XII. *A child, Water-Hill Street.*—Irish settlement; poor class of dwellings; very near the mill-pond, formed by a sluggish stream which connects Flax Pond, or Wyoma Lake, with Saugus River.

Case XIII. *A child, Boston Street, north side, near Raddin Court and near the Saugus River.*—Ground marshy in near vicinity; surroundings generally poor.

Case XIV. *Raddin Court, north side, near the last case.*—Position higher; soil apparently dry.

Case XV. *Winter Street, south side, midway between Stony and Strawberry Brooks.*—House small and poor; land wet; drainage bad.

Case XVI. *Washington Street, near Main, north side.*—Land low; house better than ordinary; apparently no drainage.

Case XVII. *A child, Laighton Street, south side.*—House of one story, with cellar and attic; stands comparatively high; cellar damp, and water backs in from drain.

Case XVIII. *Off Jenness Street.*—North side of Wyoma Lake, and within three or four rods of its margin; behind is a rocky and fairly wooded hill; surroundings apparently good.

Case XIX. On the same side of the pond and just upon its border; surroundings good.

Case XX. *Near Browne's Pond, east side.*—Surroundings good.

Case XXI. *A child, Browne's Block (Wyoma).*—East side of Main Street and close to the westerly point of Flax Pond.

Locality bad; marshy grounds, saturated with stagnant water, in rear; close by is a water-course connecting Wyoma and Wenuchus lakes.

Case XXII. *Boston Street, east side, near the lakes.*—House small, of two stories; in the lower is a barber's shop; ground in rear of house marshy and low. Two cases occurred in this house.

Case XXIII. *Adult male, Lake Street (Glenmere).*—This was an old man who lived alone in a small tenement, with a wood-house or lumber-room beneath, twenty rods or so from Flax Pond; surroundings poor; no drainage.

Case XXIV. *Adult female, Lake Street, east side.*—About the same distance from Flax Pond as the preceding case. Sanitary surroundings good; cellar in fair condition; drinking-water obtained from a pump near by; drains apparently all right; vegetables stored in the cellar.

Case XXV. *A child, Maple Street, east side.*—Distant one or two rods from Flax Pond. Premises not examined.

Case XXVI. *A child, Fayette Place, north side.*—Small tenement; no drainage; stagnant water after a rain. A few rods north of this house is a small pond.

Case XXVII. *A child, Essex Street.*—House has two stories and an attic; in fair sanitary locality, airy and pleasant; but there is a hollow in the near vicinity, on the west side and across the road, where the soil is wet and heavy and water stands after a rain. In other respects, surroundings good.

Case XXVIII. *Amity Street, lower part.*—The locality is low, near the margin of salt water, with marshy grounds around.

Four other localities were visited, but the premises were not examined. They all had apparently good hygienic surroundings.

Salem.—But comparatively few cases have occurred in this city. Early in the season, I examined, with Dr. Johnson, the following localities, where he had heard of the existence of the disease :—

Case I. *Daniels Street, off Derby Street.*—Now a dilapidated portion of the town; near the harbor; sanitary surroundings fair.

Case II. *A child, Pratt Street, off High Street.*—Surroundings generally poor. This is a sort of court, near the mill-pond.

Case III. *A child, Webb Street.*—This street skirts Collins Cove; land is low; hygienic conditions poor.

Case IV. *Adult female, South Prospect Street*—This locality is almost on a point of land, having water on three sides. Sanitary surroundings fair.

We now present, in briefest form, an analysis or *résumé* of the principal facts and circumstances received in answer to the series of questions before stated.

The details, more or less complete, of *five hundred and seventeen cases*, are given. All ages, occupations and nationalities were alike amenable to the disease. The age of the youngest patient on the record is five weeks, that of the oldest seventy years. Two hundred and thirty-one were males, and two hundred and eight were females; in seventy-eight the sex was not stated. The character of the attack in the large majority of instances was sudden, without premonition or previous noticeable illness.

The earlier and later symptoms correspond very nearly with those I have named as belonging to the disease in a former part of this paper,—violent, often excruciating, pain, referred to the back part of the head and neck, with muscular stiffness and a tendency to retraction of the head, great sensitiveness of the surface, restlessness and jactitation, with irregular panting respiration and delirium, mostly of a superficial character, were the prominent symptoms.

The condition or circumstances of the patients, whether easy or otherwise, were pretty evenly balanced.

The disease prevailed most extensively during the spring months. Of three hundred and ninety-four cases in which the date of the attack is definitely stated, ten began in January, twenty-five in February, eighty-four in March, one hundred and sixteen in April, ninety in May, thirty-seven in June, ten in July, eight in August, five in September, seven in October, one in November, and two in December. The first recorded case bears date January 6th. Relapses or decided remissions are referred to only in a minority of instances. The shortest recorded duration of the disease is two hours, the longest six months.*

It would be out of place here to enter upon the question of treatment. From the evidence in hand, we feel bound to say that no line of therapeutical management can absolutely control or cut short the disease, though much can be done to comfort and relieve the patient. The mortality in the five hundred and seventeen cases adduced was a little less than forty-four per cent. This goes to confirm the opinion expressed by many of our correspondents, that, compared with former epidemics of which we have record, the present visitation must be considered a mild one. The post-mortem records of the epidemic are few and meagre; but the developments, so far as observed, tally with the already chronicled facts in the pathological history of the disease.

The locality is stated in four hundred and forty-six cases. It is said to have been "low and damp" in one hundred and thirty cases, "low and dry" in thirty-seven cases, "low" in eighteen cases, "damp" in twenty-one cases. It was "high and dry" in eighty-nine cases, "high and damp" in seven cases, "high" in twenty-two cases, "dry" in sixty-one cases. It was said to be "medium" in sixty-two cases, and in seventy-one cases the nature of the locality is not stated. By this it will be seen that the low or damp element is somewhat in the ascendant.

* As a complication, or sequel, of this disease, ophthalmic affections are not unfrequently observed. So also affections of the ear, resulting in deafness, are not uncommon. We are permitted by Dr. Clarence J. Blake to refer to his private notebook for the year ending Oct. 1, 1873, from which we derive the following facts.

Has the disease prevailed among animals? Returns from Boston, Brighton, Charlestown, Fall River, Lynn, Newton, Stockbridge, Wakefield and Worcester, all speak of the existence of the disease, to a greater or less extent, among animals. Horses and cows appear to have been most often affected; after that hens and chickens, and in some instances dogs and cats; so that the cognomen, "pandemic," as applied to this disease by a recent medical writer, is not wholly inapt, though of somewhat questionable etymology. The following account of the disease, as it appeared to a considerable extent among horses in New Bedford, has been furnished by Dr. O. H. Flagg, a well-informed and reliable veterinary surgeon of that city. Under date of July 9th, 1873, Dr. F. writes as follows:—"Since the first of January, sixteen cases of the so-called cerebro-spinal meningitis have come under my observation and treatment. Of these, fifteen were horses and one a calf four months old. The ages of the horses varied from five to sixteen years; two only were over twelve years old; nine were males, six were females. Their symptoms were as follows:—They were attacked with violent pain, followed, in most of the cases, with a rapid swelling of the lumbar and sacral muscles, which became as rigid and hard as iron. After the subsidence of this condition the muscles became exceedingly lax and flaccid, with more or less impaired contractile power, but without entire paralysis. In one case the muscles of only one side were affected; in others this affection showed itself more severely on one side than the other. The sensation continued intact. There was, in many cases, a

Twenty-seven cases of deaf-mutism came under his observation in the time named, the origin of which he clearly refers to cerebro-spinal meningitis. Commenting upon these cases, he writes as follows:—"The majority of the cases of deaf-mutism resulting from cerebro-spinal meningitis, were presented for examination within four weeks from the time of the attack. In most of them the history was the same,—the child having heard well before the illness, and the deafness being first noticed when convalescence began. In a few cases the deafness was noticed early in the disease. In the majority of cases, moreover, the external and middle ears were in a comparatively healthy condition, the exceptions being traces of slight catarrhal inflammation of the middle ear, not sufficient to account in any degree for the deafness, which was in all but two of the cases, so far as could be ascertained, total. In these two cases there was hearing for loud noises. It is probable that the sound of their own voices in speaking was heard by some of the remaining patients, but their age rendered it difficult to determine this point." All the cases above referred to were children, the youngest being two and the oldest twelve years of age.

scanty secretion or complete suppression of urine; in others very high-colored urine, and great difficulty in evacuating the bladder. In eight of these cases opisthotonos was well marked; in three the muscles of the neck and fore extremities became swollen like those of the lumbar region before described. There was partial coma in two cases, *i. e.*, the calf and one horse. They could, however, be easily roused at any time. I saw no evidence of active delirium. In one case there was paralysis of the optic nerve of the left eye, commencing two days before death. My treatment consisted of fomentation of the affected parts with blankets dipped in hot water, which were covered with dry cloths to prevent evaporation; alternating with this the parts were bathed freely with ammonia and camphor-lotion, repeating the process until the pain subsided. Internally cathartics and diuretics were administered, followed, as improvement advanced, by nervous stimulants and tonics, along with good diet. Three of these animals died, and one other will probably succumb to the disease; the other twelve are convalescent. The duration of the disease was from five to fifteen days. The condition and situation of these animals, as to place of abode, general care, usage, etc., were decidedly varied. The post-mortem appearances were a general congestion of the psoas and iliac muscles, and also of the external lumbar and sacral muscles. The meninges of the posterior part of the spinal cord were inflamed, with a quantity of colored fluid in the canal, the amount of which I was unable to measure. The vessels of the arachnoid were full to distention, and, in spots, this condition seemed to dip down into the cord itself. There were petechial spots extending over the dorsal portion of the cord. The kidneys were inflamed (or, perhaps more properly, congested) and enlarged."

It remains to see if, from all the evidence we have adduced, any reasonable deductions can be drawn which shall throw some light upon the vexed question of the etiology or cause of this affection. It is well known that during the autumn months of the preceding year a remarkable and wide-spread disease, of the influenza type, prevailed among horses. This State suffered among others, though not, as I am aware, with exceptional severity. It was a common prediction with some

of our most intelligent medical observers that an epidemic among human kind would probably follow. In this State such prediction was certainly verified. With the advent of cold weather came an unparalleled visitation of small-pox, the like of which, for its wide extent,—for virulence and fatality,—had not been known since the times of Jenner. This epidemic ran its course, and subsided with the disappearance of the extreme cold weather of midwinter. Co-incident with this subsidence arose the epidemic with which we have now to deal, and which has prevailed, as we have seen, to a greater extent than ever before in this State. These are curious facts, —perhaps nothing more.

We have long been familiar with what is called, for want of more definite knowledge, a prevailing epidemic influence, —a certain something which pervades the air, and rests like a baleful shadow on the land. Its very mystery adds to its force, and tends to excite terror and dread among the people. This, in medical parlance, is called a remote or general cause of disease. It prevails in certain years, or at certain seasons of the year, and threatens all alike. But there are immediate or exciting causes which, at such times, determine the individual attacks. In some diseases these proximate causes are well known—*e. g.*, in small-pox it is direct contagion; in typhoid fever it is bad drainage or impurity of the air, or water, or food, or all together; in typhus, it is contagion and insanitary influences combined.

But in the affection under consideration its origin or immediate cause is not so clear. We have seen that the condition in life and the nature of the locality do not seem to have exerted any positive controlling influence in the production of the disease; neither extreme cold nor heat seems especially to favor its propagation; nor do we find any just grounds for relief in contagion as a specific cause.

The relation of insanitary conditions in and around the abode of the patient to its origin or supposed cause, demands the most careful consideration. In weighing the evidence contained in the returns, I find the scale to be pretty evenly balanced in this particular. The cases are distributed among all classes and grades of society,—the high and the low, the rich and the poor, locations unexceptionable for situation,

open to abundant light and air, and the pent-up hovels of the lowly and wretched, have all contributed to the material of the epidemic. We believe, therefore, that the *primal* origin of the disease is atmospheric, and, for the present, beyond our ken.

It would seem, however, from the multitude of facts that have hitherto been collected, that, in times of epidemic influence, in this as in other diseases of a kindred nature, any defect of known hygienic and sanitary conditions in and about the patients' residence may, if his system be otherwise made ready or predisposed, through want, deprivation, mental or physical exhaustion, anxiety, or other depressing cause, tend to precipitate an attack, while under other circumstances he might be able to withstand the general epidemic tendency and ward off the disease. We need only refer to the mass of evidence contained in the communications of our correspondents, added to our own personal investigations, as detailed in the preceding pages of this report, for confirmation of this view.

Our conclusions, therefore, while they must be, in the main, negative as to the existence of any definite exciting cause which, under all circumstances, will produce the disease, lead us to say with confidence that those communities, towns or cities whose sanitary regulations are strictest and best observed will be most likely to escape. Nor does it follow from the evidence adduced that any system of general municipal surveillance merely will suffice. It must be carried into the houses and daily resorts of the people. It rests equally upon the citizen as upon the city, to provide himself with all the means of safety in his power; to be vigilant to foresee and bar the approach of danger in the shape of houshold nuisances and impurities of every kind; to keep himself and his family from unnecessary exposure and excesses, and to govern wisely the walk and conduct of his daily life. While, therefore, we do not agree with some recent writers upon this subject, who boldly attribute the origin of the affection to these insanitary conditions themselves, we cannot resist the conviction that they are more than mere concomitants and accidents of the disease, and we must find in the lesson of the present epidemic the injunction of a stricter regard for the known requirements of hygiene in our habitations and our homes.

HOSPITALS.

BY GEORGE DERBY, M.D.,
SECRETARY OF THE BOARD.

HOSPITALS.

The object of this paper is to show that the restoration of the sick to health is better accomplished in hospitals of a simple and inexpensive construction than in those of a more complex plan, and to point out the special advantages which would come from building hospitals, whose wards should be *completely detached, the one from the other, and of a height of one story and no more.*

Our growing cities and towns feel the need of making benevolent and economical provision for the sick who may otherwise suffer in their helplessness, and for the wounded who stand in need of instant surgical relief.

From present indications it is probable that, within the next ten years, many hospitals will be built in Massachusetts, and we desire to speak no word which would tend to discourage their erection. On the contrary, there are many reasons for believing that, at the present time, small and well-arranged hospitals, in at least twenty of our busy towns, would be the means of saving life, and of preventing needless suffering to both the sick and the well.

But, in building these hospitals, let us know the errors that have been committed in the past, and avoid them; let us profit by existing knowledge of the subject, and, if possible, add to its amount. The State Board of Health, in its annual reports, furnishes a mode of communication between the medical profession and the community at large for the discussion of this and all other subjects relating to the prevention of disease and the prolongation of life, and we believe that such communication may be productive of public benefit.

Although physicians are held responsible for the usefulness of hospitals, they seldom, except in military service, have the opportunity to build them. In civil life they are as likely to

be called on for this purpose as schoolmasters to build school-houses.

Yet, if building committees could have presented to them, in direct and visible contrast, the power for saving and for destroying life which hospital-walls inclose, they might shrink from the responsibility which they now so readily assume. There is abundant evidence to show that the highest professional skill, and the most careful nursing, are so overmatched by the deadly miasm of hospital atmosphere in many of the great establishments founded by the piety and goodness of past generations, that the chance of recovery to their inmates would be improved by putting them in well-ventilated sheds, or tents, or even in summer by providing only the simplest defence against rain.

A great change is now going on in the opinions of physicians throughout the world concerning hospitals. Their construction, their management, their power to lengthen or to shorten life,—their agency in originating, retaining or distributing certain forms of disease,—their influence for good and for evil,*—have been the subjects of constant discussion during the past twenty years. Every one has seen the good they may do to the community, both directly and indirectly, by giving aid and comfort to those who would otherwise be supremely wretched in their helplessness, and by the opportunities they afford the medical profession for the instruction of its younger members. All this is plain, but the other side of the picture has been, until recently, obscure.

Modern inquiries are giving the world more light, and stimulating investigation and comparison. Both the remote and proximate causes of disease are now subjects of general inquiry: the possibility of preventing disease to individuals, to classes and to communities is no longer thought visionary.

Hospital reform has been recently advanced by the studies of pathologists, chemists and philosophers, concerning the obscure something which seems to be the seed of infectious disease.

* The writer has in his possession some cases of surgical instruments which were used in the Revolutionary War. They bear this inscription, which would be equally appropriate for the portals of hospitals,—"*Mille mali species, mille salutis habeo*" (I have a thousand forms of good and evil).

Recent theories of fermentation, of the origin of infusorial life, of the process of decay of organized substances,—problems exciting such interest as to be discussed in the monthly magazines and in popular lectures,—all these are closely connected with our subject. Moreover, it is evident that, independent of these ideas which now perplex the student, there has been in the minds of physicians a tendency (founded on close observation, not on theory) to extend the number of diseases which are capable of direct transmission from one individual to another, or of propagation by some medium like clothing or woodwork in which the infectious element may remain latent for a longer or shorter period and then be suddenly developed. Some very fatal diseases are suspected of becoming convertible, or of being so nearly related that, under certain circumstances, the one may give rise to the other. Erysipelas and puerperal fever, erysipelas and pyœmia, scarlet fever and puerperal fever, are examples. We think it may be said that each of the later generations of physicians finds a larger number of diseases classed as communicable. The inevitable epidemics diminish: the avoidable infections increase. Of those which are now regarded very differently from the teachings of thirty years ago, we may mention scarlet fever, erysipelas, typhus and typhoid fever, diphtheria, puerperal fever,* and Asiatic cholera.

There are now practitioners who are inclined to believe that the catarrhal fever, known as influenza, is not to be looked upon in all cases as an unavoidable epidemic, but as one which may be directly communicated from one member of a household to another; and some careful observers think this contagious character may be traced in all affections sf the mucous membranes, attended with purulent discharges.

Our correspondence of last year shows that consumption is now closely questioned in this respect. The drift of medical opinion is all in this direction; *increasing the list of diseases which may be regarded as, under certain conditions, communicable.*

* Dr. Oliver Wendell Holmes, in an essay on the contagiousness of puerperal fever, published in 1843, brought forward ample evidence to show that this disease could be communicated from the sick to the well. We think it has never since been doubted, at least in New England.

Hospital reform has been also promoted by the more precise knowledge we now have concerning air and its contents, coming from the studies of chemists and microscopists; and of ventilation and the need of a great supply of pure air for the preservation of health and, *a fortiori*, for the cure of disease. Great progress has been made in both these fields of exact knowledge, and their application to existing hospitals has been made by physicians and surgeons of both civil and military service in all parts of the world.

It is evident enough to those who have not been immediately engaged in the discussion which has arisen during the past few years, that the old hospital system is not approved, and that very radical changes must be made. The dispute still goes on in all European countries and in America, and the end is not yet. It is, however, clearly foreshadowed, and must be met by those who would establish hospitals which can bear the criticism of the future. It will not be surprising if our successors of the twentieth century shall look back with something of the same wonder and pity upon our great hospitals of to-day with which we regard the descriptions of the old Hotel Dieu of Paris, or St. Thomas of London, in the last century. They will surely do so, if the present mortality of the great hospitals of those cities shall be reduced to the present mortality of the hospitals of fifty beds in the same countries. If the present mortality after amputations in the great hospitals of New York and Boston can be reduced to the mortality after amputations in private dwellings, there will be good reason for the claim of increasing knowledge of the causes of death.

A hundred years ago the Hotel Dieu often sheltered at one time, and under one continuous roof, two and three thousand patients suffering from bodily injuries and every form of sickness, mingled indiscriminately with diseases now known to be infectious, in wards without adequate provision of either air or light, and two, and often three, patients were laid in one bed. One out of every four who entered the hospital died. London hospitals of that period were better; but even there patients were mixed up and crowded in the wards in a manner which would now be regarded as wicked.

From that period to the present time, physiology, pathology,

chemistry and the physical sciences have been advancing, and never more rapidly than now. Their application to hospital construction and to hospital reforms has been slow but inevitable. The power of unpolluted air to maintain health, and the vitally depressing effect of foul air on both the sick and the well, have been partially recognized. Such hospitals as the Hotel Dieu, or the Beaujon, or the Charité of thirty years ago,* are no longer built; but we find Lariboisière, with its high rooms and separate pavilions, and enormously complicated system of artificial ventilation, which expresses the recognized need of what, unfortunately, it fails to supply. Patients suffering from diseases known to be infectious are now separated from others, or at least the attempt at separation is made. But the demand for greater security against preventable sickness, both in and out of hospitals, is very far from being satisfied.

The question recurs constantly, and with increasing force, not only whether our hospitals present every opportunity for the restoration of health, but whether they do not contain in themselves forces which actually oppose or retard or prevent recovery. The wards of a hospital, it is to be remembered, are, unlike any portion of an ordinary dwelling, occupied continuously, day and night. Its occupants give rise, in addition to the usual excretions from the breath and the skin, to special forms of impurity. Suppurating surfaces throw into the air pus-cells in a state of decay; the urine and fœcal discharges add to this dangerous material, quicken its decomposition, and make it still more dangerous; the special poisons of special diseases (if such things exist) mingle with this foul "stirabout." † The result of all this is, that a pernicious atmosphere is generated, which unless special and constant pains be taken to get rid of it, fastens itself upon woodwork, clothing, and everything which holds moisture. It is not

* The student of medicine in Paris at that period cannot fail to remember the dark, low, gloomy wards in which he followed Chomel and Louis and Roux and Velpeau, in the early morning, in an atmosphere oppressive with foul animal odors which had accumulated through the night, nor to recall the terrible mortality which followed surgical operations executed with consummate skill.

† Professor Huxley is responsible for this word. In his address to the British Association, at Liverpool, he says, in speaking of the air of inclosed places, "Ordinary air is no better than a sort of stirabout of excessively minute solid particles."

difficult to see why hospitals should sometimes tend to lower the vital force of their inmates, nor is it strange that special diseases should sometimes haunt their walls. From the time when oxygen was discovered to the present moment, the value of unpolluted air, as a remedy, has been more and more clearly seen. Angus Smith and Pettenkofer are but following the path marked out by Lavoisier and Priestley; and the world at large is gradually becoming convinced that here, indeed, we have the true elixir of life. To secure it in abundance is the most essential thing in the reform of hospitals. With it all else becomes simple and practicable; without it no real progress can ever be made.

Among those who have made practical demonstration of the value of unpolluted air to the recovery of the sick, and who have led the way in hospital reform in these latter days, the name of Miss Florence Nightingale is conspicuous. Her noble personal efforts in the Crimean War, and the book on hospitals which followed, have made the world her debtor. It was an application of heroic impulses, with the teachings of science, to a great work; and it fixed the attention of all thinking people in every civilized country.

If the Crimean War was the direct means of destroying, it was also the indirect means of saving lives in all subsequent time through the terrible lessons of hygienic neglect, which it made known in such a manner that no one could fail to understand them. The "Notes on Hospitals" brought the subject before the builders and supporters of these establishments with a force which is plainly felt at the present time. Government commissions were ordered to examine them. Comparisons of mortality in the various British hospitals were made by the registrar-general. Hospital reform became at once a subject of general and popular concern.

Dr. Simpson,* of Edinburgh, took up the subject of hospitalism with characteristic energy. Recognizing the many elements of doubt which are included in the usual contrasts of hospitals and their results, he fixed upon the amputations of limbs as affording the best standard of comparison, and pursued his inquiries in this direction until a great number of

* Works of Sir J. Y. Simpson. Vol. II.

these cases had been collected from town and country, from hospitals of all sizes and grades, and from surgeons not attached to hospitals, in Scotland and England. The whole number of cases of amputation of thigh, leg, arm and forearm was 4,187, and these, which had occurred in almost equal proportions in hospitals and in country practice at the homes of the patients, showed that the ratio of mortality in the smaller provincial hospitals was less than half as great as in the great hospitals of London. This was indeed a startling fact. Moreover, out of 2,089 amputations in hospital practice, 855 died; out of 2,098 amputations in country practice, 226 died.

The difference, astonishing as it appears in the above figures, is, however, far greater when certain special amputations are compared. Thus, in hospital practice, out of 244 cases of amputation of the arm between the elbow and the wrist, 40 died; while in country practice, after 377 cases of the same operation, only two died. To return to limb amputations in general, Dr. Simpson showed that in hospitals of from 300 to 600 beds, one in two and a half die; in hospitals of from 100 to 300 beds, one in four die; in hospitals of from 25 to 100 beds, one in five and a half die; in cottage hospitals under 25 beds, one in seven die; and in isolated rooms in country practice, one in nine die. Dr. Simpson also refers to the enormous difference in the mortality from pyœmia (surgical fever) after amputations in hospitals and in private practice. This generally admitted fact is attested by a comparison of statistics collected by various writers.

Taking all these figures as the basis of his argument, Dr. Simpson presented his views of hospitalism at great length in a series of propositions, which are most strikingly put, and which have made a permanent impression. They have been disputed in every form, but their general correctness, we think, is now pretty well established. His conclusion is that in the treatment of the sick there is ever danger in their aggregation, and safety only in their segregation; and that hospitals should be constructed so as to avoid as far as possible the former, and secure as far as possible the latter condition.

A report* on hospital hygiene in Great Britain was made to the government, in 1864, by Dr. Bristowe and Mr. Holmes, one a physician and the other a surgeon, who were appointed by the medical officer of the privy council, Mr. Simon, to give the subject thorough examination. This was by far the most complete exposition of hospitals and the hospital system which had been made. It deals with an infinity of details, and in its conclusions must be regarded as a defence of British hospitals against the criticism of the advancing knowledge of the period. While protesting against the death-rates being taken as a certain index of the salubrity or success of any hospital, and pointing out the many sources of error in the comparisons of hospital results, it admits the proved danger of erysipelas, pyœmia and cognate diseases in both surgical and lying-in wards, and insists upon the infinite importance of better ventilation, better drainage, greater bed space and more scrupulous cleanliness, as means of preventing the occurrence and the spread of these causes of death. Mr. Simon's remarks upon the report of the commission, in the same volume, are of extreme interest, and touch upon many points of hospital hygiene, all of which are made clearer by his philosophical and masterly treatment. The following extract will give his views of several important points: "That which makes the healthiest house, makes likewise the healthiest hospital; the same fastidious and universal cleanliness, the same never-ceasing vigilance against the thousand forms in which dirt may disguise itself in air, in soil and water, in walls and floors and ceilings, in dress and bedding and furniture, in pots and pans and pails, in sinks and drains and dust-bins,—it is but the same principle of management, but with immeasurably greater vigilance and skill; for the establishment which has to be kept in such exquisite perfection of cleanliness, is an establishment which never rests from fouling itself; nor are there any products of its foulness, not even the least odorous of such products, which ought not to be regarded as poisons. Above all, this applies to the fouling of the air within hospital wards by exhalations from the persons of the sick. In such exhalations are embodied the most

* Sixth Report of the Medical Officer of the Privy Council.

terrible powers of disease,—the spreading flames, as it were, of some infections, and the explosive fuel of others; and any air in which they are let accumulate, soon becomes a very atmosphere of death. Against this danger, ventilation is the one possible safeguard,—ventilation which, with continuous current, shall always be bearing away, as rapidly as evolved, every volatile taint which rises from the sick. So that, for hospital hygiene, ventilation requires preëminent regard. And if ever the phrase 'well ventilated' may be (though it never ought to be) at all indulgently construed in respect of a common dwelling-house, it must never, in respect of a hospital, be construed but with the utmost conceivable strictness."

Dr. Evory Kennedy,* of Dublin, excited renewed interest in the question of hospital reform, by a paper on zymotic diseases and puerperal fever, presented to the Obstretrical Society in 1869. Dr. Kennedy's position as an ex-president of the Irish College of Physicians, and ex-master of the Dublin Lying-in Hospital, gave his opinions a wide influence throughout the medical world, and led to a discussion of the hospital system in its application to midwifery by the Dublin practitioners, which, in completeness as well as brilliancy, has been rarely equalled in medical literature. Dr. Kennedy did a very praiseworthy work in making known the convictions of his mind concerning the influence of great lying-in hospitals in propagating fatal diseases, and a very brave work in meeting the natural conservatism and pride of his brethren with reference to an institution like the Dublin Hospital, whose foundation dates back more than a century, whose wards have in this period received 200,000 patients, and whose fame is known throughout the world. But he bore himself nobly in the fight, and is now receiving the reward of good service. He has strengthened the hands of all hospital reformers. Dr. Kennedy showed from the hospital records that the deaths in that establishment had been to the whole number of patients received, one in 72 for the whole period of its existence, rising in some years to one in 30 to 40, once to one in 19, and once to one in 14; while the death-rates from all the accidents of childbirth in a series of years for the whole population of England

* Dublin "Quarterly Journal of Medical Sciences." 1869.

and Wales had been one in 223, of Scotland one in 225, and of London one in 239. Dr. Kennedy contended that a great portion of this mortality was preventible, that it had its origin *in the hospital*, at times haunting certain wards, and was propagated from one patient to another chiefly by infection of the atmosphere of the building, and that the remedy would only be found in breaking up this great establishment, and providing detached cottages, each of which should give accommodation to two patients, and no more.

Dr. Kennedy's argument corresponds with that of Dr. Simpson, the one referring to parturient women, with special reference to their danger from puerperal fever, and the other to amputations of the limbs, with special reference to surgical fever. These two affections (metria and pyœmia) have many pathological resemblances which are now universally recognized, and they are, of all known diseased conditions, those which every practitioner most dreads to meet. In hospitals they are almost always fatal.

Mr. Paget, one of the most eminent of living surgeons and pathologists, stated, in 1862, that, "in every case of erysipelas, pyœmia, or the like, we ought to work till we discover the probable origin; we should have the strongest feeling that these diseases are not spontaneous nor inevitable. In every case the hospital or the house or our own practice should be brought to trial,—to private trial if you will, yet a just trial, —a trial before our own conscience; and if the hospital, the house or the practice be found guilty, let it be condemned and amended. Of all the remedies I have used, or seen in use, I can find but one thing that I can call remedial for the whole disease pyœmia,—and that is a profuse supply of fresh air."

American experience with civil hospitals corresponds with that of Europe. Except in our largest cities, there have not been in the past so large a number of destitute persons as would require other hospitals than those attached to almshouses. Great lying-in hospitals do not exist in America; and, with the warnings we have had on this subject, it is to be hoped that the care of this class of patients may always continue to be in small and detached establishments. New York, Philadelphia, Boston, Cincinnati, and other cities have great

general hospitals, and some of them, through the fame of their surgeons, attract very large numbers of surgical cases.

The following table will show the comparative mortality from the amputation of limbs in four American hospitals, viz.: the New York Hospital, the Pennsylvania Hospital, the Boston City Hospital, and the Massachusetts General Hospital, contrasted with the mortality in nine London hospitals. The American figures are derived from a pamphlet entitled "Amputations at the Massachusetts General Hospital," compiled by Dr. James R. Chadwick, in 1871; the English figures are taken from Dr. Simpson's essay on Hospitalism. The American statistics extend, in the case of the Massachusetts General Hospital, as far back as 1823; the London statistics are for different periods, but all included between 1861 and 1868. Both the American and English figures include amputations for disease, and primary and secondary amputations for injury.

	Four American Hospitals.			Nine London Hospitals.		
	Whole Number.	Deaths.	Ratio of Deaths.	Whole Number.	Deaths.	Ratio of Deaths.
Thigh,	404	139	34.41	459	211	46.
Leg,	481	143	29.73	352	155	44.
Arm,	195	34	17.44	145	51	35.1
Forearm,	205	29	14.15	101	18	17.8

This contrast is in our favor; but, when it is remembered that our hospitals are smaller than those of London, the difference is only such as might be expected in accordance with the rules of Simpson and Kennedy, that the mortality is (other things being equal) proportional to the size of the hospital, or the aggregation of the sick in one establishment.

We are not aware of any effort having been made to collect amputation statistics in private practice in the United States, but can see no reason why they should not present similar results to those collected in Great Britain. It is to our military rather than to our civil hospitals that we must look for instruction in hospital hygiene. This experience has been on a prodigious scale during the recent civil war. Such opportunities for comparison of various methods of providing for

great numbers of sick and wounded men have never before been presented to the world; and, fortunately for the interests both of humanity and science, the army authorities, early in the war, saw the wisdom of leaving this department to be managed by the medical profession whose special training had fitted them for the work. Had the European customs and traditions—hampering the medical department with the authority of general officers—been followed in our army, such results could never have been reached.

This freedom of the medical staff gave opportunity for the trial of hospitals in every form. Churches, warehouses, factories, private dwellings were thus occupied for our wounded; wherever lumber could be got rude buildings were made on any plan which seemed best to the medical officers; tents were used when they could be had, and were made comfortably warm by stoves, open fire-places, and underground pits from which the smoke was ingeniously conveyed to the outer air.

Finally, and as the result of all these improvised means of sheltering those who were disabled by sickness or wounds, there was gradually formed a system of hospital construction, of which the distinguishing features were these: 1st, buildings of one story; 2d, ventilation in summer directly through the ridge in its whole length, and in winter by wooden shafts, warmed by the smoke-pipe of the heating-apparatus, whatever it might be, and leading straight through the roof. They were, in all cases, detached pavilions, and freely exposed to air and light, but in these respects can claim no originality. Never before in the history of great wars has been found such immunity from erysipelas, surgical fever, and kindred affections to which all great hospitals are liable, as in these simple constructions.

The truth of the remark of Sir James Paget concerning pyœmia, which we have already quoted, was constantly illustrated.

The soldiers got, within these buildings, that most powerful of all remedial agents, and that most important of all preservers of vitality, fresh air; and as soon as they could crawl out of doors there were no stairs to prevent them from so doing.

These lessons have not failed to instruct the medical profession everywhere. In the European wars which have since occurred, we find that wherever American experience has been followed (and this has been very general) the results have been good and satisfactory. The opinions of French and German surgeons seem to be entirely in accord with those of the United States, and both are founded on very wide observation, and their testimony is to this effect.

The chance of recovery to both sick and wounded is better in the rudest barracks to which air has perfectly free access, or in tents, than in the most elaborate and completely appointed hospitals of great cities, in which the plans for supplying air are artificial.

An application of these principles to civil hospitals already established, both here and in Europe, is by no means readily accomplished.

These establishments are rooted in conservatism. Connecting the piety and charity of the past with the relief of suffering in the present generation, they seem hardly less sacred than the Church itself.

They are great monuments of benevolence; and this is outwardly expressed by architecture of the most imposing and enduring character. To destroy them and to build barracks in their stead would be thought sacrilegious. They can, however, be amended and improved; and this is already being done in some instances. Meanwhile the whole subject of new hospital construction is undergoing change.

In England, Capt. Galton, already well known in connection with improvements in heating-apparatus, has recently written an excellent treatise* on hospital architecture, giving much useful instruction, but stopping just short of what seems to us to be the essential reform † of the future.

Another indication of the need of change is found in the apparent popularity of what are known in England as "Cottage Hospitals," designed for from three to six or eight beds,

* The Construction of Hospitals, by Douglas Galton. London. 1869.

† He protests against piling up the sick in many successive layers or stories, but is willing to compromise for two. The advantages which come from the simple forms of ventilation which may be used in a building of one story he does not appear to see.

having the general character of a small country dwelling, with one nurse, who is also cook and general manager, under the direction of a committee of benevolent persons. The success of these rural hospitals seems to be complete, if we may trust to the evidence of the author of a recent book* about them. They seem, however, to be specially adapted to a state of society quite unlike anything found in an American town or village. In so far as they show the advantages of having only a small number of sick under a single roof, their experience is to be noted as of value.

In the establishment of new hospitals for cities and towns, we may reasonably hope that the warnings of past experience and the results of recent investigations will be remembered. The time of great collections of sick people under one roof has gone by. Every diseased person is now to be regarded as an element of more or less danger to those about him, and the effort must be made to reduce this danger to the smallest possible amount consistent with such association of the sick as may be required for purposes of economy, of convenience, of professional care, and of nursing.

It must always be kept in view that the chief purpose of a hospital is the restoration of the sick to health in the shortest possible time. If other considerations stand in the way of this grand object, they must, when fairly recognized as obstructions, be put aside.

When it is made to appear that the mortality of hospitals increases in geometrical ratio with the number of their inmates who breathe a common atmosphere, the opinion of the world will demand that they be subdivided until the minimum of disease is reached. When it is clearly understood that great and many-storied hospitals generate a poison which may infect either the healthy or unhealthy body; that they lower the vitality of those who breathe their air; that the chances of life to sick or well are diminished by living within their walls,—in short, when it is understood that such hospitals are among the preventable causes of death, public opinion will demand that they be demolished, and that the sick shall be

* Handy Book of Cottage Hospitals, by Horace Swete. London. 1870.

taken care of in such manner that these dangers shall not be encountered.

That all the terrible evils above enumerated may fairly be charged upon such hospitals as the Hotel Dieu of Paris, or the Rotundo Lying-in Hospital of Dublin, within a period of fifty years, we think no physician will deny. Since that time reforms have been slowly made, and they are still going on.

At the present moment such ideas are prevalent in the medical profession concerning "hospital influence," that no surgeon can be found rash enough to undertake the operation of ovariotomy in any great hospital of America or Europe. In houses of ordinary convenience, and in rooms supplied with air of unquestionable purity, this operation is attended with no greater mortality than amputation of the leg or arm—far less than the amputation of the thigh,—but in our great hospitals death from ovariotomy is found to be almost certain. Such considerations lead to the conviction that we have by no means attained the standard of healthfulness in hospitals at which we must aim, and which will finally be reached.

This growing faith, having a foundation in the daily observation of physicians, the evidence of statistics of hospital mortality, and the studies of experimental philosophers of the present day, tends strongly towards the segregation, and against the aggregation of the sick. On the other hand, it must always be recognized that the care of the sick can be economized by placing them in such position that the wants of large numbers can be met by a simple organization of physicians and surgeons, as well as of nurses and cooks and attendants. The service of the most eminent physicians and surgeons can, perhaps, only in this way be secured to the poor; and the advantages of medical and surgical education and comparison which hospitals afford to the young men who are to be the physicians and surgeons of the future can hardly be over-estimated.

What, then, can we do? How secure these advantages to the whole community, and avoid the special dangers to hospital inmates? All plans to accomplish these objects point in the same direction. They all look to the breaking up of great hospitals, except for purposes of administration, into completely detached parts, so that each shall have its

own atmosphere and borrow nothing from its neighbors; and they all insist upon this atmosphere, which the patients are compelled to breathe, being as free from the impurities which hospitals constantly generate, as the ingenuity of man can possibly provide.

These being the sanitary requirements which the improved knowledge and benevolence of the world will finally insist upon, whether they prove to be more or less convenient or expensive, we think they are met by detached pavilions of the simplest construction, and by building them of *one story in height, and no more.* Such requirements will demand that architectural pretensions shall be set aside. Stately piles of hospital buildings will, we think, in the future, be regarded as the monuments of those who have needlessly died within their walls, rather than of the charity and benevolence of their founders.

All systems of supplying the needed amounts of fresh air to hospitals of more than one story have failed. The most elaborate artificial contrivances do not meet this fundamental want. From the Lariboisière at Paris to the City Hospital at Boston, they are failures, one and all, and the machinery for suction or propulsion being found inadequate, resort is had to natural currents of wind, or to such movements of air as can be established by its own weight when heat is applied or removed. With hospitals of one story better ventilation can be had both in winter and summer, by means infinitely more simple, and capable of management by persons of ordinary intelligence; greater air-space can be afforded, and the inmates can get the benefit of the outer air and sunshine just as soon as they are able to walk.

Another point of infinite importance in the building of hospitals, is to guard against the slow and gradual contamination of the wards themselves by emanations from the sick. We think that this requirement may be met by having wards enough to leave one or more at all times unoccupied, and completely exposed to the purifying effects of air and sun. This can readily be done with one-storied pavilions.

It is evident that a great hospital arranged on this plan would, in some respects, be less, and in others, more expensive. Greater ground-space would be required,—the greater

the better. The cost of construction would be very much less than in the many-storied palaces, but the cost of administration would certainly be greater. Fuel, and the service of the hospital, would be additionally expensive. Whether these would be counterbalanced by the cheapness of the original outlay for buildings, we are unable to say,—probably they would not. But this is not a mere question of cost, not one of ordinary economy, but of economy of life, and it cannot be put aside with the usual arguments of thrift.

We do not enter upon the minute details of hospital construction for several reasons. They involve the discussion of a great number of questions, and would tend to make less prominent the radical errors which we think have been committed in the past, and which should first be corrected.

Many of the difficulties, indeed, which have occasioned much controversy and book-making, would disappear if our recommendation of one-storied wards, completely detached from each other, were adopted. The vexed question of hospital ventilation would be simplified.

Suction and propulsion by artificial methods, which require for their working that windows shall be kept closed, and that the machinery be worked by skill of the highest order capable of appreciating not only changes of temperature and season and atmospheric pressure, but of insuring the efficiency of the whole apparatus by day and night, would be replaced by a system in which the opening and closing of windows and ridge-valves would always be simple and practicable. The heating-apparatus, whether of steam, hot water, or furnaces, might also be so arranged under each ward as to warm the floor, and thus remove the evil of a difference of temperature of from ten to twenty degrees between the top and bottom of the room, as is now generally found in winter. Every ward should also have one or more capacious fire-places, for burning any fuel which may be convenient. Open fire-places cannot be exclusively depended on for heating a ward in so severe a climate as ours, but in many months of the year they would be sufficient for this purpose. At all times their additional ventilation would be of the greatest value, while the radiant heat from flame, by warming the floor and the furniture and the clothing and bodies of the

inmates without a corresponding heating of the intervening air, supplies the needed warmth in the most advantageous way possible for the sick. The cheerful effect of an open fire in a sick-room or ward can never be dispensed with.

Communication by a common atmosphere being absolutely cut off by completely detached pavilions, the largest hospital need have no greater mortality by reason of its size or extent than one which would be represented by the number of beds in a single ward. Should the pests of hospitals appear in one of these subdivisions, another would be vacant and ready for instant occupancy, while the infected one could, in turn, be exposed to air and sunlight, and, if need be, artificial disinfection.

The importance of putting a hospital on solid ground, and on soil which may, to a great extent, purify itself by aeration if human contrivances fail, as they are sure to do sooner or later, is too obvious to require discussion.

Circumstances may sometimes require that hospitals shall be less fortunately placed, but we are inclined to believe that rather than build them on such soil as that occupied by our two great hospitals of Boston, it would have been better to bring in gravel enough from the surrounding country to raise their foundations at least fifteen feet above their present level. If the patients could not be carried to the neighboring gravel hills, the hills should have been brought to them.

Concerning the arrangement of wards and nurse-rooms and water-closets and bathing-rooms, as well as kitchens and administration, the best materials for floors and walls and other details of importance, much useful knowledge will be found in the books to which we have already referred, especially those of Miss Nightingale and Capt. Galton, and in a valuable report on the barracks and hospitals of the United States Army, by John S. Billings, Assistant Surgeon U. S. A., and in Circular No. 2, Surgeon-General's office, 1871.

POLITICAL ECONOMY OF HEALTH.

By EDWARD JARVIS, M. D., of Dorchester.

POLITICAL ECONOMY OF HEALTH.

"HEALTH IS THE CAPITAL OF THE LABORING MAN."—*Latham.**

In estimating the power or the value of a state or nation, two factors are commonly used,—

1. The number of the people.
2. The value of their property.

In the first the people are simply counted; men, women and children,—all have equal share in this enumeration; the infant and the mature, the strong and the weak, the healthy and the sick, are all presumed to contribute an equal portion to the body politic.

Numbers have, in themselves, no power. They are merely representatives of things that may be nominally alike, but infinitely various in their degrees of value.

A community of children in the forming stages of life, or of invalids, or of patients in hospital, or lunatics, is very different from one that includes only persons in the mature and effective periods of life.

As the nation's wealth consists of the sums of all the estates within its borders, the great and the small, deducting all incumbrances, mortgages, debts, etc., so the strength of the state is the sum of all the effective people, deducting all the personal incumbrances, sicknesses, disabilities, and imperfections.

Thus, the state that has the largest proportion of its people in the years of maturity, from twenty to seventy, is stronger

* Sanitary Engineering.

and wiser than one that has a larger proportion in the immature period of childhood and youth; and one, all of whose members are in fulness of health and strength, is stronger than one, any of whose people are disabled with fever, consumption, lunacy, intemperance, etc.

Every increase of individual estate, every dollar earned, and every new value created, is so much addition to the common wealth, and every detraction from the wealth of individuals, every dollar that is expended without return, wasted or squandered, every extinguishment of any value, is so much taken from the public capital; and all incumbrances, debts, mortgages on property of persons, must be deducted from the sum total of the common wealth, in order to obtain a true estimate of its worth.

So all additions to the physical, moral or intellectual power of individuals, all strengthening of the arm and increased skilfulness of the hand, all culture of the brain, sharpening of the perceptive faculties, or discipline of the reflective and reasoning powers, in any individual, are, to that extent, additions to the energy and the productive force, the effectiveness and the wisdom of the state; and, on the contrary, all deductions from these forces, whether of mind or body, every sickness, any injury or disability, every impairment of energy, every clouding of the brain from intoxication, all waste of mental discipline, take so much from the mental force, the safe administration of the body politic. Collective personal gain is public gain, and aggregate personal loss is, to the same extent, the suffering of the community.

The State thus has an interest, not only in the prosperity, but also in the health and strength and effective power of each one of its members; and it has a claim upon all to develop their estates and themselves, bodily and mentally, to the greatest extent, and add each one to the aggregate wealth and power of the whole.

The period of development is from birth to the completion of the twentieth year. From twenty to seventy is the period of maturity and efficiency. From seventy and upwards is the period of old age, when men rest from their labors.

The years of growth, of old age, constitute the dependent

periods. The years of maturity, from twenty to seventy, are the sustaining period.

The labors of these fifty years—twenty to seventy—create substance sufficient, not only for the support of the worker of that time, but for the early years of growth, and also the ordinary period of decrepitude, after seventy.*

The effective power of a nation is in the number of its people in the sustaining period, and in the proportion these bear to the dependent classes. In all the United States, among the whites, 49 per cent. are in the sustaining class,† and 51 per cent. in the dependent. Among the colored the proportions were 44.78 per cent. supporters, and 55.22 consumers. A wide difference in this respect is seen in comparison of the Northern States with those of the South. In Vermont the sustaining classes are 53 per cent., and in Massachusetts, owing, in part, to immigration, 56.8 per cent., while the dependent classes in these States are, severally, 47 and 43 per cent. On the contrary, the sustaining classes in North and South Carolina are 46, and in Georgia 47 per cent., while the classes depending on others for support are 53 and 56 per cent.

A similar difference is found in analyzing the populations of Europe. The following table shows, at a glance, the proportions of the sustaining and dependent classes in various countries.

* These are general averages, not applicable to every individual. Many earn sufficient for their support, under the direction of others, before they are twenty years old; but even these are not contributors beyond their consumption to the public capital. As a class, they do not mature until this period is passed. On the opposite extreme of life, some retain their strength and labor after passing their seventieth year; but more begin their rest in decrepitude before that age.

† This is due, in some measure, to foreign immigration, which brings a large proportion in the middle period of life,—twenty to forty years old.

*Proportions of the Sustaining and Dependent Classes.**

NATION OR STATE.	Year.	Sustaining — 20 to 70.	Dependent. Under 20.	Over 70.	Totals.	Number dependent for 1,000 sustaining.
France,	1866	60.32	36.09	3.64	39.68	657
Massachusetts (white),	1870	56.80	40.30	2.80	43.10	759
Switzerland,	1861	56.20	41.22	2.58	43.80	779
Belgium,	1856	54.61	42.51	2.88	45.39	831
Sweden,	1860	54.51	42.67	2.82	45.49	834
Denmark,	1860	54.30	42.76	2.94	45.70	845
Spain,	1858	53.46	44.66	1.48	46.14	863
Holland,	1859	53.52	44.15	2.33	46.48	868
Prussia,	1869	52.62	45.34	2.03	47.37	880
Vermont,	1870	53.30	42.50	4.50	47.00	900
England,	1861	52.21	45.04	2.74	47.78	915
Scotland,	1851	51.30	45.60	2.95	48.55	946
Norway,	1865	50.78	45.44	3.77	49.21	969
United States (white),	1870	49.04	49.18	1.80	50.98	1,039
South Carolina (white),	1870	46.70	51.20	1.90	53.10	1,136
North Carolina (white),	1870	46.04	51.70	2.06	53.96	1,153
Ireland,	1841	46.50	52 03	1.48	53.51	1,201
United States (colored),	1870	44.80	53.60	1.50	55.10	1,229
Georgia (white),	1870	44.40	53.90	1.50	55.40	1,248

* From the censuses of these nations and states.

Thus it is seen that the effective force of the nation is not represented by the total number of the people, but by the number in the effective or productive age, and this is again qualified by the burden of supporting the dependent classes, which are constantly with them.

It appears from this analysis, that there is a wide difference in both these respects between different countries.

The proportion of the sustaining class in France exceeds that in Ireland by 35 per cent. The proportion in Massachusetts exceeds that of the whites in the Carolinas and Georgia by 38 per cent., and in England it is 12.9 per cent. greater than in Ireland.

Comparing the sustaining power with the burden laid upon it, the demand was 94 per cent. greater in Ireland than in France. On the whites, it was in the Carolinas 50 per cent., and in Georgia 60 per cent. greater than on the people of Massachusetts.

Ideal Life.

In the ideal state of vitality, which now falls to the lot of some individuals, but not on the whole community, all that are born survive to enter the matured stage of life; all who enter this stage labor through it, and then live to their four-score and first year. In such a population of 80,000, there are 20,000 in the forming period, 50,000 in the productive or effective period, and 10,000 in old age. The labor of five years supports eight. In the effective period, the man provides sustenance, not only for himself while laboring, but for his children, and for himself when past labor.

This is far from being the common lot of man. Everywhere and in every age human life is arrested.

The following table shows the proportion of 10,000 born in each country that reach maturity and fulness of age:—

Of 10,000 born: *

COUNTRY.	Survive 20.	Survive 70.
Norway,	7,415	3,487
Sweden,	6,698	2,557
England,	6,627	2,379
United States (males),	6,543	2,559
Hanover,	6,121	1,607
France,	5,022	1,176
Ireland,	4,855	861

Beside the natural love of live, and the comfort and happiness from length of years, which all hope to enjoy, the State has an interest that all should reach maturity, and then labor and contribute to the common strength and wealth as long as possible.

* Calculated from the National Life Tables.

Norway.—"Norges officielle Statistik, Folkmœngdens Bevœgelse," 1856-65, p. 217.

Sweden.—"Sveriges Officiela Statistik, Befolknings Statistik," 1856-60, p. 75.

England.—"English Life Table No. 3, p. 24. Dr. Farr in Registrar-General's Report, 1864."

Hanover.—"Bevölkerung und den Lebensdauer," 1846. Ta. B. xxvii.

Ireland.—Census of Ireland, 1844, p. lxxx, &c.

United States.—L. W. Meech—Life Table Males, in Insurance Report, Mass., 1868, p. ciii.

In this economical view, man may be considered as a productive machine, which creates property or sustenance for itself and the Commonwealth. Then a child that is born is but a vital machine begun. But it is powerless and ineffective, and must be built up and developed and grown and trained for work. This is a perilous and doubtful process of twenty years.

It seems, by table on page 339, that in Norway, the most favored country, 25 per cent. perish in the forming period. In the United States, 35 per cent. of the males, and in Ireland, 51 per cent., fail to reach maturity. In Norway, only 34 per cent. ; United States, 24 per cent. ; and in Ireland, less than 9 per cent. enjoy the full period of working years.

In the ideal state, every twenty years expended in the development of manhood and womanhood, results in the completion of a matured laborer. But in the actual experience of the world, a varied portion of this expenditure is lost by death in this period.

In the production of dead machinery, the cost of all that are broken in the making is charged to the cost of those which are completed, and the prudent manufacturer charges all that he expends on the failures to those that succeed, as a proper part of the cost. Thus, if two fail, when half finished, for every one that is completed, the cost of the finished one is doubled; and this increase of cost is in proportion to the expenditure which has been made or lost on those that broke down in the process.

So in estimating the cost of raising children to manhood, it is necessary to include the number of years that have been lived by those that fell by the way, with the years of those that pass successfully through the period of development. With this view, the following table has been prepared to show the number of years that were lived by children and youth under twenty, for every 1,000 that reached the fulness of maturity :—*

* Calculated from the Life Tables.

COUNTRY.	Years spent under 20.	Per cent. Loss.
Norway,	2,142	7.1
Sweden,	2,182	9.1
England,	2,192	9.6
America,	2,233	11.16
United States,	2,251	12.55
France,	2,327	16.35
Ireland,	2,514	25.70

As the great majority of those who were lost died in infancy and early childhood, the sum of the years that they had lived was small compared with that of those who passed safely through the whole period. But yet there is a great difference in this respect in these several countries. The loss in Ireland was 120 per cent. greater in the first year, 75 per cent. in the first five years, and 120 per cent. greater in the period of growth, than in Norway.

Financial View.

Beside the pain, anguish and sorrow caused by these early deaths, they deeply concern the State as a matter of political economy.

Simply as a vital productive machine, a child at any age is worth the cost that has been expended on him for his support and development. The cost of the support and training of children is widely various, from that which sustains bare animal life, to the lavish luxury of the opulent; but taking the lowest estimate for the laboring population, it, on an average, costs not less than fifty dollars a year. Then a child of ten is worth $500; and at maturity $1,000, and the death of either of these is so much loss to the Commonwealth.

Both English and German political economists calculate the value of man at all ages, from childhood to old age, and come to similar conclusions from very different bases.

Death of Children and Youth in Massachusetts

By the Thirtieth Report of Mortality of Massachusetts, page 146, we find that in the seven years, ending with 1871,

81,029 died under twenty in the State. Their ages are all given in years to the fifth, and in quinquennial periods, from five to twenty. With these facts and the life table, it appears that the whole sum of their lives amounted to 292,762 years, which, at $50 a year, had cost $14,638,100. This sum had been paid from the estates, income or earnings of their families, and diminished to that extent the income or the capital of the Commonwealth. This sum, invested in the life of these 81,029 children and youth, was lost in the course of seven years, and so much, or an annual average of $2,109,157, was lost to the State by premature death.

The blessing which these perishing children were to their families in their shortened lives, cannot be measured nor told in any language; the heart alone knows the joy at their appearing and the agonizing sorrow at their early departure. But the Commonwealth only knows these as the promise of usefulness which was not and never can be fulfilled.

Working Years.

The life tables of the several nations show that all fall short of their ideal in various degrees. The average duration of effectiveness enjoyed by the people, between twenty and seventy was,* in—

Norway, ...	39.61	years.
Sweden, ...	38.10	"
United States, males, . . .	37.46	"
Hanover, ...	35.81	"
England, ...	35.55	"
France, ...	32.84	"
Ireland, ...	28.88	"

Thus the productive efficiency fell short of its fulness 20.78 per cent. in Norway, 23.7 per cent. in Sweden, 25.08 per cent. in the United States, 28.38 per cent. in Germany, 28.9 per cent. in England, 34.3 per cent. in France, and 42.24 per cent. in Ireland.

* Calculated from Life Tables.

Death in Working Period in Massachusetts.

In Massachusetts, during the seven years, 1865 to 1871, 72,727 died in their working period. In the fulness of health and completeness of life, they would have had opportunity of laboring for themselves, their families and the public, in all 3,606,350 years, but the total of their labors amounted only to 1,681,125 years, leaving a loss of 1,925,224 by their premature death. This was an average annual loss of 276,461 years of service and coöperation. Thus it appears that in Massachusetts, one of the most favored States of this country and of the world, those who died within seven years had contributed to the public support less than half, 46.07 per cent., of what is done in the best conditions of life.

Sickness.

Nor is this loss by early death all that the Commonwealth suffers in diminution of productive power in their period presumably devoted to profitable labor. Even while men and women live they are subject to sickness, which lays a heavy tax on their strength and effectiveness.

No exact account has been yet taken of the amount of sickness in this country. But the experience and investigations of other nations enable us to approximate this matter. In Great Britain there are many organizations under various forms and names, as Benefit Societies, etc., which include many hundred thousand members of all ages. A prominent purpose of their association is to support each other, when deprived of the power of labor by sickness. For this purpose, each member makes certain contributions weekly or monthly to a common fund, and in return receives a certain weekly amount, varied according to the contribution or other circumstances, when sick or otherwise disabled from labor. The treasurer takes account and makes record of the time and duration of the sickness or disability, with other facts, as age, sex, disease, the occupation of the applicant, etc. By this means a full record is made of all the sickness and injuries of a very large portion of the men, women and children in every part and in all the employments of the kingdom.

The government, wishing to measure the productive power

of the people, gathered these records, made through many years, and placed them in the hands of the best investigators and calculators to analyze and combine them and show the proportion and amount of sickness that fell on males and females, children and adults in every age from childhood to the last years of life, and in the various occupations and conditions of society. The results of these labors are published in the Parliamentary Reports on Benefit Societies. Finlaison, Neison, Ansel, Macullagh and other statisticians have written very instructively on this subject. Thus the amount of sickness and the proportions of time lost in consequence of sickness or disability at each age is shown as it existed through many years, and is the basis of expectation for people in like conditions and circumstances. It is not to be supposed that every individual will have just his quota of sickness in every year, nor is it said that this has been each one's experience. But these are the averages of all.

American Health Assurance Companies.

Some years ago there were several Health Assurance Companies in operation in this country, offering for certain premiums, varied according to age and circumstances, to be paid at fixed periods, to pay out certain amounts a week, whenever the assured should be sick. For want of any record or knowledge of the experience of the people in this country, they assumed the British rates as their guide in fixing the amounts that should be paid in as premiums and returned in time of sickness. On this basis they adjusted the rate of premium and relief in such a manner as they supposed would leave the companies a reasonable profit. But unfortunately, in the result, there was not only no profit, but a loss, and the companies were compelled to close their offices and cease to insure. The premiums paid in were insufficient for the allowances promised in the time of sickness. The demands were greater than they had calculated; there was more sickness than the British records showed as their experience in England and Scotland.

It is safe, then, to assume that the amount of sickness or disability is, at least, as great in the United States as it is in Great Britain, and the rates found in the British reports may

be used as a means to determine or approximate the amount of sickness in Massachusetts among the people of the working age, 20 to 70.

At the last census, in 1870, there were 796,252 of this class in this State. The British rates of sickness for each sex, at each age, are given by Finlaison,* in days for the males, and in weeks and fractions of a week, by Neison,† for the females.

Applying these several rates, in each of the quinquennial periods from 20 to 70, to the population of Massachusetts in 1870, it appears that there was in that year among the people of the working productive age a total amount of 24,553 years and eight months sickness or disability, when so much opportunity for labor was lost to our people.

This is not all the loss of labor and production by means of sickness. These rates are from records of the treasurers of the benefit societies of the periods during which they paid money in aid of the sick members. Their rules allow no payment for periods short of a full week. It is presumed that for a disablement of a period less than a week the members can take care of themselves, and will need no aid from the society. The records, then, do not include the manifold lesser ailments that are frequently occurring,—colds, headache, temporary rheumatism, slight injuries, toothache,—which suspend the power of labor for one, two or more days, yet less than a week, and therefore not recorded. Beside these there are many slight ailments that are insufficient to confine one to the house, or even keep him from his workshop, yet impair his energy and lessen the effectiveness of his exertions.

There is another and remarkable exception to the fulness of the reports of sickness. The government report says that in this analysis, "nothing but sickness, in the true sense of the word,—that is, sickness incapacitating from labor, and requiring constant medical treatment, and of limited duration, as contra-distinguished from *chronic ailment*, and mere decreptitude,—was considered to be sickness; for instance, slight paralysis, blindness, mental disorder or senile infirmity

* Parliamentary Report on Sickness in the Friendly Societies, August 16, 1853, p. xxvii.

† Contributions to Vital Statistics, p. 410.

cannot, it was thought, be fairly classed with the sickness commonly prostrating the workman, and for relief under the ministrations of which he seeks the aid of a benefit club."*

It is manifest, then, that very much of the disability that prevents work and causes loss of production is not in the record, and that much of the actual loss, by impaired health and energy, fails to be noticed in the calculation, and is therefore not included in the rates herein quoted from the British reports.

There is another consideration. These friendly societies, being practically health insurance companies, must sustain themselves, and make their payments out of constant and sufficient assessments. They are not charitable institutions, except so far as the recipient of charity and aid has already paid that which he asks. None but those who can make the regular payments are admitted; and none are retained, except as long as they comply with the conditions of unfailing contributions. Hence the poorest, the idle, the profligate, the intemperate, those who earn but little, or who spend their earnings in drinking, are excluded, or, if admitted, are dropped from the roll. These are the classes who have the most sickness. The same rule would exclude many feeble lives,—persons suffering from hereditary disease or chronic ailments,—consumption, asthma, epilepsy,—who either never had health sufficient to become contributors, or fail to ask for admission before they became so impaired.

From all these causes and conditions, a large portion of the disabilities of the people does not appear on their records, and the rates which are found on the tables, on which these societies base this class of their operations, and on which our health assurance companies endeavored to carry on their work, do not signify the whole extent of the disabilities, either there or here.

It is estimated by the English observations and calculations that for every death there are two constantly sick; that is, 730 days' sickness and disability for every death.

It appears, then, that in Massachusetts, in 1870, there was a loss in the effective period equal to 276,461 years by prema-

* Parl. paper, August 12th, 1853.

ture death, and 24,553 years by sickness, making 301,014 years' loss of force on productive power in a single year. There was the same proportionate loss in the previous year, and there is no reason to hope that it will not be the same in ratio of the numbers of the living for years to come, unless some happy change shall come over the sanitary habits and condition of our people.

Comparison of Periods of Development and Labor.

If there were no deaths in this period of growth,—if none fell in the process of development, and none in the effective period,—then every twenty years expended in the early stage would produce a mature man or woman, and be followed by fifty working years. But, as already seen, much time is expended on those that are lost in the period of growth, and the period of labor is shortened by the deaths between 20 and 70. Having the number that are lost in the maturing period, and the number of years that they have lived, and also the number that die in the effective stage, and the duration of their labors, it is easy to draw a comparison between them, and show the cost, in years, of creating and maturing human power, and the return which it makes in labor in compensation.

By this double measurement of life, in its incompleteness and in its fulness, it is found that for every 1,000 years expended in the developing period, upon all that are born, both those who die and those who survive the period from birth to 20, the consequent laboring and productive years are,—

In Norway	1,881	years.*
Sweden, ...	1,749	"
England, ...	1,688	"
Hanover, . . .	1,686	"
United States, males, .	1,664	"
France (1806), . .	1,398	"
Ireland (1841), . .	1,148	"

It costs less to develop a man in Norway than in any other

* Calculated from Life Tables.

country. It was shown in the article on Infant Mortality,* that a larger proportion of infants survived their first year in Norway than elsewhere, and these children, when grown, have the greatest power of endurance that the records of life and death reveal. Comparing those people who are thus endowed with persistent vitality with those of the opposite extreme,—the Irish at home,—it is seen that a thousand years spent in the growing period produce 63 per cent. more of working life among the Scandinavians than among the Celts. In this respect the Norwegians are 13 per cent. more favored than the Americans, and the Americans 44 per cent. more favored than the people of Ireland.

The World's Work done between Twenty and Seventy.

In this period of life,—twenty to seventy,—shortened as it is by premature death and weakened by sickness, all the work of the world is planned, directed and performed. This age gives to the nation its physical and mental power, its wisdom, and its effectiveness. It directs the affairs, public and private. It earns the income, produces the sustenance, and creates the wealth. Nearly all the property, capital and value in the world are created by human power in this period.

Nature and Man Partners in Creation of Wealth.

In this work—the creation of wealth—nature and man are joint partners and coöperate together. Nature contributes the material, man gives it value by putting it in such form, combinations and position as to make it available. The contributions of nature are worthless as they lie in her hands; but they have a prospective value, in proportion as they can be manufactured, by the power and skill of man.

The earth, air and water produce vegetation (tree, herb and fruit), but these are useless, and nearly worthless, to the world until the human hand shall convert them and fit them for use. In the simplest matter of property, the tree standing in the forest has a small price. In Massachusetts, in various places, it is sold from fifty cents to two dollars a cord. The woodman cuts it down and divides it into parts fit for transporta-

* Massachusetts Fourth Report Board of Health, 1873, p. 193.

tion, and thus adds 50 to 100 per cent. to its value. The teamster carries it, on his sled or his wagon, to market, and thereby increases its value from $5 to $10 a cord; the wood-sawyer then divides it into portions fit for burning, and then it is worth $7 to $12 a cord. Of all this value nature contributes but a small proportion, and the brain and muscle of man gives the rest. This disproportion of contribution is increased in the production of other forms of wooden merchandise. The fine woods—mahogony, rosewood, black walnut—are found in distant forests, some, in the tropics, of difficult access. They are brought within the reach of mechanical art by ships, railroads and horses; then they are wrought into furniture, musical instruments and ornaments, with skill and force of handicraft; and when, at last, they appear in forms of chairs, bureaus, pianofortes, flutes, articles of graceful adornment, etc., they have a value in the market, compared with which its worth in the living forest is an almost inappreciable trifle.

The metals in their manifold forms constitute a very large part of the world's pecuniary capital. Nature furnishes the original raw material of these in the ores of the earth. The ore of iron is often deep in the recesses of the ground, inaccessible except through pits and shafts, which must be made by the power of human labor, digging through the loose earth and blasting through rocks. The ore is removed with great labor from its bed and brought to the surface of the earth, submitted to the process of metallurgy, and at length is made into bars for the smith's and the manufacturer's use. Finally, through the process of the shop and the factory, it is converted into articles of hardware, locks, nails, wheels, machinery, etc. In all these processes human skill and labor add so much to the value of the material, that what originally had hardly a price has become a small fortune.

The "New American Cyclopedia" (IX., 589), says, a bar of iron worth $5 is worth $10.50 in horseshoes, $55 in needles, $3,285 in pen-knife blades, $29,480 in shirt buttons. In this property of $29,480 the iron represents only $5 and labor $29,475. And carrying the analysis of value farther back to the ore in its buried place in the earth before the soil had been removed from the surface, or the strata of rock blown

and broken from about it, or even a road had been made from civilization to the ore-bed, it is manifest that human labor has given most of the value of the iron bar, and a few cents, more probably a few mills, would represent the total value of the ore in its original position. Then these few mills' worth of the natural ore is but the nucleus around which the labor of man may gather value a hundred fold, thousand fold, ten thousand fold; and this is the proportion that the joint partners —nature and man—contribute to the capital finally vested in the merchandise of iron and steel.

Buildings.

The capital in buildings, dwellings, shops, factories, and of many other kinds, which is one of the great elements of the world's wealth,—these, like others herein mentioned, are the handiwork of man.

Nature gave the lumber in the living tree, in the remote forest; the marble, granite, sandstone; the lime for the mortar in the subterranean, and, in large portion, distant quarries; the brick in the clay-pit; the iron for the nails, screws, hinges, locks, etc.; the copper, tin, lead and zinc, in the original ore in the earth; the elements of the paints also in their raw and uncompounded state, before the mind of man had devised a way to reach them, or the hand of man had lifted a shovel, spade or pick-axe to take possession of them. It is plain that in this great property, as elsewhere, the analysis of the origin of value shows that it is nearly all the result of human labor, —the work of the hand guided by the brain.

Effective Population in 1855, 1865 and 1870.

In this State the numbers of the effective population were,—

In 1855,	626,476*
1865,	709,542*
1870,	828,448†

Who did, or presumptively could, by their labor, contribute to the income and capital of the Commonwealth.

* State Census, 1855 and 1865.
† National Census.

Productions and Valuation of Massachusetts.

In Massachusetts the total valuation of the taxable property was,*—

In 1865, ...	$996,841,901
1870, ...	1,417,127,376
1872, ...	1,696,599,966

The productions of industry, agricultural and mechanical,—

In 1855, were	$295,820,681†
1865, "	517,240,613

All these statements are but approximations to the truth. The valuation includes only the taxable property, and omits that which was not taxable. These exceptions are large. They include all public property, belonging to the State, counties and towns, public buildings, roads, streets, and United States bonds.

These would swell the valuation to a much larger amount. But it is sufficient for the purpose to say that there was a capital in the State amounting, in 1865, to $991,841,906 in the care of 709,542 people of the working age, and in 1870 there was a capital of $1,417,127,376 in the care of 828,448 people to use and utilize it, and that in 1865 these people produced or put in condition of use $517,000,000 worth of property. This was an average of $729 for each one between the ages of twenty and seventy. These amounts of production include both the estimated value of the raw material used in the cost of labor in the production, in the total value of the articles when they passed out of the hand of the manufacturers.

In this way some articles are valued more than once, as the leather, which is valued and included in the productions of the tannery, passes into the hands of the shoemaker and harness-maker and is again included in the production of shoes and harness factories. So also paper re-appears in publishers' productions; hinges, nails, screws, doors, sashes, blinds, etc., in the value of buildings; cloth in clothing.

* State Reports: Taxation, Property, etc.

† State Reports, 1855–1865.

It is impossible, from the returns, to make corrections for this repetition, although the separate town reports and the county summaries give the values of the materials used, leaving it to be inferred that the remainder of the production is to be accredited to labor, rents and interest, yet this is generally for individual articles, of which in this respect no summary is given. In some manufactories the cost of the new material is large in comparison with that of labor.

The material of clothing costs . .	$11,000,000
Goods made, ...	17,000,000
Boot and shoe stock, . . .	35,000,000
Goods made, ...	53,000,000
Woollen stock, ...	35,000,000
Goods made, ...	52,000,000

In some others, the cost of material was about half the value of goods made, and others the labor was the main cost of the whole.

In farming the production is given with no cost of material. For want of an exact statement it may be safe to give $300,000,000 as the approximate amount of labor expended in the productions of these $517,000,000 in 1865.

But it must be further considered that this includes only the labor expended on visible articles of vegetation or manufacture. Even in these employments there are many occupied whose labor sends no products nor wares to market. The repairs of buildings employ many carpenters, masons and painters. The repairs of vehicles and harnesses gives occupation to many coach and harness makers. Jobbing blacksmiths, tinmen and many other mechanics render great service to the community, which does not enter these records. There are manifold mechanic shops which are not establishments, and are not included in the report. No note is taken of tailors, dress-makers who go from house to house, nor of personal and household service, the men and women of all-work; the cook, the washer-woman, the hostler, the day laborer, the stone-wall builder, nor of the laborers on public works, railroads, highways, streets, building making and repairing; nor of all the earnings of hotels, boarding-houses,

of professional men, of teachers. These occupy no small portion of the people, who create value in their respective ways. Their earnings are not, and cannot well be, stated in the form of this report; but if added, they would very greatly swell the gross amount, and carry it with the earnings therein indicated up to the full $517,000,000 given.

Relation of Labor and Capital.

All this capital, $991,000,000 in 1865 and $1,696,000,000 in 1872, in Massachusetts, is intrusted to the care of the effective classes, who utilize it, and produce the value already stated, earning thereby sufficient for the sustenance of themselves and their families, and to increase the capital of the Commonwealth over $400,000,000 in the five years, 1865 to 1870, and $279,592,590 in the two years next following, 1870 to 1872.

The production by human agency is very great in proportion to the capital, and both production and capital increase rapidly.

In the ten years, 1855 to 1865, the production increased 75 per cent. In the ten years, 1861 to 1871, the value increased 73.79 per cent. and in the five years, 1865 to 1870, this increase was 42 per cent. The amount of production accomplished by those within the laboring period, abridged and burdened with sickness and disability, indicate the amount of vitality, health and strength enjoyed by them between early maturity and the beginning of old age.

Moral Aspects of Health.

In this paper, thus far, account has been taken only of the productive power of the people, and this is measured by the length of the effective period which they enjoy, and their financial results. These are the only facts in this connection which are recorded and given to the world. They are the only reliable means of comparing the ideal and desirable life with the actual experience. They are the facts on which states and governments necessarily rely when they estimate their own worth and power, and when they compare themselves with each other.

Man's physical energy and power of creating property, as thus described, although the most necessary element in his

earthly being, is not the whole of human life. But in this connection, with its gains and its losses, it may be taken as an indication of the proportion of comfort and happiness that is enjoyed or lost through his other and higher elements connected with the intellectual and moral nature. The pleasure of mental and spiritual culture, of domestic and social affections,—all that elevate man above the earth,—are not to be measured by the financial scale ; but they are measured by their opportunity and duration, which are the same for them as for labor. All of man's enjoyments, both physical and spiritual, in this life, are multiplied by lengthened years and diminished by premature death.

It is natural for all men and women of sound mind to hope to possess a fulness of life, and to retain their strength to the last years of old age.

Man is a religious being. Resignation to the will of the Creator is a prominent element of his spiritual nature. He accepts the conditions of life,—seemingly established beyond power or expectation of change,—and he looks for death, at any moment, from the first, when infancy dawned, to the last, when a century or more of years shall have passed over him here. When his friends are taken from him, he submits to the unalterable decree with mingled sorrow for the loss and thankfulness that so much had been granted. Nevertheless, all hope for length of days, for complete development and maturity, and for the full opportunity of labor in their strength, and for deferred and protracted old age, and that they may, at length, lay themselves down to rest after having done all of life's work, and enjoyed all of life's blessings, that earth can afford.

Interest of the Government in Health.

It is manifest, then, that the first and largest interest of the State lies in this great agency of human power,—the health of the people. Herein is all its strength. This creates and manages all its wealth, and the chief responsibility of the government is to protect it and, if possible, to enlarge it and make it more and more productive. But here the government, the representative of the State, very naturally asks what it can do in this matter. There is apparently no way nor op-

portunity for its interference. It would gladly prohibit fevers and all other diseases, if it would have any effect. It prohibits theft and murder, and is generally obeyed. But here it feels powerless. It cannot prevent the attack of sickness, nor resist its destructive force. It cannot arrest the hand of death, nor prolong human life by any act of legislation. All this is in the hands of a higher power, whose messenger is disease, and whose agent is death. What and where, then, is the responsibility of the State for the health of its members? Whatever may be the interest in, or sympathy with, the suffering and the sorrowful, when health fails or life is taken away, it is powerless before the causes, and, with the mourning people, must bow in submission to the fiat of the inevitable.

There is a double error in this reasoning. First, life is not a fixed quantity to which it must come, and beyond which it cannot pass; second, the body politic, both in this and in other countries, sometimes directly and sometimes unconsciously, has interfered in this matter, and life has thereby been expanded, strengthened and prolonged.

The laws and conditions of life, in all its manifestations,—in vegetable, in animal, in man,—are determined, and cannot be changed; but the circumstances which surround life, and the measure of conformity to the appointed conditions, are infinitely various, and the degree to which life is developed and sustained is in accordance with them.

Agriculture.

For ages, one of the greatest studies of mankind has been to know exactly the laws which nature has established for the life of vegetables, plants, grains, fruits, roots, and of animals, cattle, sheep, fowls, and to learn and adapt the necessary circumstances to these requirements. So far as people have been successful in this search, and faithful to their knowledge, they have developed a larger life in this field of culture. Hence we have better, stronger and more useful cattle, larger and more nutritious grains and fruits for human sustenance, and better and richer herbs and grass for the support of domestic animals. The original apple, as offered by nature to mankind, was the small, sour, bitter crab of the forest, unpleasant,

indigestible, innutritious. By diligent and intelligent culture, it has grown to be hundreds of delicious and nutritious varieties. The pear, the peach, the plum, grapes and berries, have had a similar development from beginnings as humble and unpromising. Potatoes, beets, parsnips, beans and manifold other garden vegetables, have a similar history from small originals, through gradually increasing expansion, to their present richness and worth in the scale of nutrients. Fowls, sheep, swine, cattle,—all the varieties of animals which man has taken under his care in their present state,—have advanced as much from their primitive condition as the vegetables. One hundred and sixty years ago, in 1710, Dr. Davenant, a writer on political economy, estimated that the average weight of dressed cattle did not exceed 370 lbs., and that of sheep 28 lbs. In 1795, a committee of parliament stated that these animals had increased one-fourth in weight and size within fifty years. In 1846, McCulloch stated that, "at present the average weight of cattle is estimated at or about 800 lbs., and that of sheep at or about 80 lbs." "The weight of these animals has a good deal more than doubled in a little more than a century." *

Whenever it has suited the purposes of man, and he has used the appropriate means, the strength of horses and cattle, and all their available qualities, have been increased, and they have become more and more useful to the world.

Thus, agriculture and horticulture, in all their varieties, are neither more nor less than the culture of the living principle in some of its forms, the adaptation of circumstances, and supplies to the necessities of each beast, fowl and insect, each plant, grain and leaf, and giving them their appropriate means and opportunities of growth.

Increase of Human Life.

Man, himself, has happily followed in the same path of improvement. By better adaptation of means, circumstances and habits, his life has been expanded, his strength increased, and his days on earth prolonged. By the improvements in agriculture and in vegetable and animal life, he has obtained

* Account of the British Empire, II., p. 515.

better and more constant food, and is therefore better nourished. By the improvements in the arts, he is better clothed and housed, better protected from the elements. The progress of civilization is best manifested in the progress of vitality. There is less sickness, and that which visits humanity is less destructive than in former ages.

The records of these most important facts are unfortunately few; yet these all concur in their testimony to the increase of man's longevity.

In ancient Rome, in the period two hundred to five hundred years after the Christian era, the average duration of life in the most favored class was thirty years.* In the present century, the average longevity of persons of the same class is fifty years.

The records of life and death in Geneva, in Switzerland, for the last three hundred years, are more complete than any others now known. These show that the expectation of life from birth, or the average longevity, was—

21.21 years	. . .	in the 16th century.
25.67 "	. . .	17th "
33.62 "	. . .	18th "
39.69 "	. . .	from 1801 to 1833.
40.68 "	. . .	1814 to 1833.

In the 16th century, 25.92 per cent. of the children died in their first year. In the 19th century, the deaths at this age were reduced to 15.12 per cent.

In the 16th century, 61.11 per cent., and in the present century only 33 per cent., perished before they reached maturity at twenty.

In the first period, 3.08 per cent. passed their threescore and ten years, and in the latter 17.94 per cent. had that length of life.

As large proportion now live to seventy as lived to forty-three, three hundred years ago.†

* Ulpianus quoted in Pandectæ Justiniani, Lib. 35. Tit. 2. Ad legem Falcidiam.
† Mallet in Annales D'Hygiene, XVII., 169.

British Tontines.

In 1693, the British government borrowed money by selling annuities on lives from infancy upwards, on the basis of the average longevity of the people of that century. The treasury received the price and paid the annuities regularly as long as the annuitants lived. The contract was satisfactory to both parties. The government obtained the money at a reasonable cost, and the annuitants received their principal and a fair interest, and no more.

Ninety-seven years later, in 1790, Mr. Pitt issued another tontine or scale of annuities, on the basis of the same expectation of life as in the tontine of the previous century.

These latter annuitants lived so much longer than their predecessor, that it proved to be a very costly loan for the government. It was found that while 10,000 of each sex, in the first company of annuitants, died under the age of twenty-eight, only 5,772 males and 6,416 females in the second company died at the same age, one hundred years later. The annuitants of 1693 enjoyed an average life of twenty-six years and six months. Those of 1790 lived thirty-three years and nine months after they were thirty years old. Within the century, included in this history, the longevity of this class of people increased twenty years.*

In Sweden the expectation of life at birth was thirty-five years and three months from 1755 to 1775. It was forty-three years and five months from 1841 to 1855. The average deaths were one in 36.2 of the living from 1746 to 1767, and one in 47.3 from 1842 to 1855.†

In France, of 1,000 born, the survivors to twenty, in 1781, were 458;‡ in 1806 they were 558, and in 1861, 628.§ One million births in 1746 would support a constant population of 35,938,543, and in 1865 39,815,520.‖ Moreau de Jonnes, says, "The improvements in nutrition among the people of

* Dr. Southward Smith, in Trans. Brit. Social Science Assoc., 1857, p. 498.
† Befolknings Statistik, 1851–55.
‡ Buffon's Works, II., 515.
§ Legoyt Mouvement de la Population, 1861–65, p. xci.
‖ *Ibid.*, p. xcii.

France have reduced the mortality one *moitié*. The mortality was one in 25 in 1782, and one in 43 in 1861 to 1865.*

A similar diminution of death and prolongation of life has been granted to other nations in the progress of civilization. The marked effect of the improvements in life is seen in the increased proportion that reach maturity, and of the effective population between twenty and seventy. The dependent class is thereby diminished and the sustaining class is increased. According to the Genevan record, the average working period has increased from eight years and five months to twenty-two years and eleven months within three hundred years, and consequently old age is postponed. Those who were formerly old at fifty and decrepit at sixty, are now old at seventy and decrepit at eighty.†

From these facts, it is plain that life, in many forms and manifestations, and probably in all, can be expanded in vigor, intensity and duration under favorable influences. For this purpose, it is only necessary that the circumstances amidst which, and the conditions in which, any form of life is placed, should be brought into harmony with the law appointed for its being. By this means the intelligent world has been and is now continually adding to the vitality of the vegetable and animal kingdom, as far as they are brought under their control. Man has increased his own life, also, in as far as he has conformed his self-management to the requirements of the vital law.

Beyond the pale of man's intelligent aid, life is apparently stationary. So far as human observation has gone, the wild, uncultivated plants, the trees of the forest, the grass of the meadows, the flowers of the untouched wilderness, the fishes of the sea, the birds of the air, insects, reptiles, wild beasts of the desert, left to their own instincts, are no larger nor stronger; they have no more vital force or longevity than in the beginning of their race on earth.

* Peuples d l'Antiquité.

† Calculated from Mallet in Annales D'Hygiene, XVII.

Influence and Power of the Government in Agriculture.

In most, if not all, civilized nations, the government, which is the concentrated wisdom of the people, has taken an especial interest in agriculture, and lent its aid in the promotion of its prosperity. In Massachusetts it has encouraged the formation and efficiency of agricultural societies, through which it has wielded great influence on the improvement of the productions of the farm and garden. The legislature makes annual appropriations, amounting to nearly thirty-four thousand dollars in this and the previous year. Nearly eighteen thousand dollars is given to the various agricultural societies, and is distributed by them in premiums for excellence in culture and productions of the field and garden, etc.

Board of Agriculture.

A board of agriculture is established by the State, composed of the best agricultural talent and accomplishment in the Commonwealth. They have a secretary, a man of large power and acquirement, wholly devoted to the work of his vocation. They have rooms in the state house, where is gathered a library of the best books, pamphlets and journals relating to farming, both American and foreign. These are offered freely for public use, and all who will, are invited to come and read or consult them.

Agricultural Societies.

There are thirty-one agricultural societies in Massachusetts, in which probably every town is represented by some or many of its farmers. At their meetings and exhibitions, the best agricultural wisdom of their several districts is brought forth. The best plans of cultivation that have been suggested, matured and tried on the farms, even in the obscurest corner, are there brought forth and the results exhibited. Specimens of the best products of the earth in every variety, grains, fruits, roots, whether grown for man or beast, are presented. These show what intelligence, skill and faithfulness can accomplish in the development and expansion of animal and vegetable life; and the methods used for these purposes are

described for the instruction of all. Thus the knowledge and experience of each is made the common property of the whole community. The best agricultural and horticultural lights are placed on the hill-top, so that all cultivators may be guided by them.

Co-operation of Collateral Sciences.

The government enlists the coöperation of men of learning, scholars in all collateral sciences, philosophers, naturalists, botanists, chemists, mineralogists, geologists, ornithologists and entomologists. These investigate the nature and habits of plants, the character and relations of soils, the composition and power of manures, natural and artificial, and other elements of vegetable nutrition, and their relation to the quantity and quality of crops. The habits of insects injurious to vegetation, and of birds that are favorable to it, and the physiological character and pathological dangers of domestic animals, are all subjects of these scientific inquiries. Reports of great value to the agricultural interest are made on them, and manifold other topics connected with the cultivation of the earth.

Some of these reports are printed by the State in separate volumes. Others, with essays on every variety of topics useful to the farmer, the discussions of the agricultural board, and the gatherings they draw in various parts of the State, and the reports of the agricultural societies are collected and published in annual volumes by the secretary, and distributed at the cost of the public treasury freely and gratuitously among the people.

Thus the State has, in manifold ways, obtained the aid of the science of her scholars, and the practical wisdom of her cultivators, to teach the best way of creating the largest life in plants and animals. The people have profited thereby. A marked effect has been produced on the public mind. Routine farming disappears; thought, system and improvement take its place, under this liberal and sagacious leadership and encouragement of the government.

In this work the legislature and people have gone hand in hand, mind with mind, heart with heart, to effect their common purpose. Agricultural newspapers have sprung up in every part of the land. They find their way into a large part of the

farmers' houses; they offer another and very wide opportunity for writers and experimental cultivators to teach their lessons. Those who take these papers profit by their instructions, and apply them to their daily practice. They learn, not for themselves alone, but diffuse these blessings to their neighbors, so that few or none can avoid the light and influence of these journals.

Farmers' clubs are formed in many towns, and hold earnest and profitable meetings. They are excellent schools of mutual instruction on the manifold topics connected with their vocation.

These and other instrumentalities for the agricultural education of the people, here and elsewhere, have had so much influence that this interest has become a ruling power in the civilized world. It forms public opinion; it controls the habits and sensibilities of cultivators, so that they aim to develop and sustain the best animal and vegetable life, and feel ashamed of meagre cattle or unskilfully managed fields.

Human Life Expansible as in Animals.

Human life is subject to the same condition as the life of beasts that work for man, as that of the animals and vegetables that supply him with food. The vital laws are equally determined in all living beings. Each has its own appointed requirements, and its vitality and power are in proportion to its opportunity to fulfil them. Intelligence of these laws, and conformity to them, produce the same effect in all, whether man, beast or plant. By means of this regard to the laws of their being, the vital energy of cattle, fruits, etc., is developed and sustained in high, perhaps in the highest, degree. But for the want of this regard, human vitality is incompletely developed and imperfectly sustained. Few of our cattle die in immaturity; but many of our children sink in this stage of their being. Man suffers more from sickness, in all his stages, than his animals, for whose health and protection he faithfully provides. A larger proportion of his race than of his horses perish in the middle and active periods of life, and a smaller proportion reach their fulness of years and die of old age.

Can Government Aid in Improving Human Life?

Is there room here in this field of human life for governmental coöperation as well as in the agricultural field of vegetable and animal life? It is powerful there. It is not powerless, and need not be ineffective, here.

The power of the government is threefold, and is exerted in a triple way.

It is mandatory, and says, thou shalt and thou shalt not.

It is permissive, and grants privileges.

It is advisory, instructive and encouraging.

It teaches the people their best interests, and points the way of gaining them.

By the second of these methods it has aided in the advancement of agriculture,—it grants money. But mainly in the third method has it done this great work.

By all the three methods it has wrought its work in education. It has ordered a certain amount of schooling, in ratio of the population and the due facilities of houses, teachers, books, etc. It permits the people to raise more money and obtain for their children a higher and more liberal education.

In the third method the government instructs, leads and persuades the people. By the board of education, the normal schools, teachers' institutes; by enlisting the aid of the talent and learning of scholars, who can write and speak; by the reports in which are condensed the wisdom and experience of the teachers throughout the State,—by all these and other means the State has created such popular sentiment, that the people, in all the towns and districts, demand and support schools of high order, in which every child may be taught and fitted for usefulness in the world.

Vital Legislation.

The government of Massachusetts has been accustomed, from its early periods, to take cognizance of public health, and has endeavored to protect the people from some of the causes of injury. The law offers some protection against contagious diseases, small-pox, etc., and also against nuisances, offensive trades, etc. In some degree it proposes to regulate tenement-houses; it endeavors to save children from

the exhaustive effect of over-labor in factories; it authorizes boards of health to abate nuisances of wet and foul lands, etc.; and, lastly, in the creation of the State Board of Health, and endowing it with ample authority, it has taken large and very wise steps in this direction. All these show that the government recognizes its interest in, and responsibility for, the health and working power of the people, and its determination to lend its authority for their promotion.

So far, these laws have had some effect in some places, but they are ineffective in others. There are manifold sanitary evils yet to be abated. The work assigned to the Board of Health has been prosecuted with great energy, and, as far as it has been able to go, with signal success. But ages must elapse before the single hand, authorised by the law, can accomplish the herculean task assigned to it, and required by public necessities. The field of human life is everywhere spread about us, and the harvest of tares and weeds is ready for the sickle, but the laborers appointed, though skilful and diligent, are very few.

European Sanitary Legislation.

Some of the European governments watch over the health of their people with jealous and anxious care, and endeavor to surround it with all the safeguards that modern science can suggest. They find many sanitary evils, which are the growth of ages, that have come down from the periods of barbarism. These are rooted in the habits and conditions of the people,—in the physical condition of the earth,—in the structure of cities,—in the locations of towns and dwellings. They seem to be an almost inseparable element in the social organism.

The British parliament are singularly alive to this work, and have ordered many inquiries as to the health of the people; and, led by the reports of their sanitary officers and commissions, many laws have been enacted for the benefit of public health. In the annual lists of laws that are passed, these are very prominent:—

1839. Metropolitan improvement act.
1840. Chimney-sweepers act.
Bakehouse regulation act.
Print-works regulation act.

1840. Dyeing-works regulation act.
Passengers act.
1841. Vaccination act.
1843. Vaccination act.
1846. Fever in Ireland act.
Baths and wash-houses act.
Nuisance removal act.
1847. Towns improvement act.
Baths and wash-houses act.
1848. Health of towns act.
1849. Nuisance removal and disease prevention act.
1850. General board of health act.
1851. Interment act.
Lodging-houses act.
1852. Smoke nuisance prevention, in London, act.
General board of health act.
Vaccination extension act.
Registration of births, marriages and deaths, in Scotland, act.
Public health act.
Nuisance removal and disease prevention act.
1854 and 1855. Burial-grounds, in Scotland, act.
Public health, supplemental act.
Burial grounds, in Ireland, act.
1856. Nuisance removal act.
Smoke nuisance abatement act.
1862. Registration of births, marriages and deaths, in Ireland, act.
Vaccination, Ireland.
Vaccination, Scotland.
Drainage, in London, act.
Nuisance removal act.

It is manifest from these titles, taken from the lists of a few years, that the British government take a very deep interest in sanitary matters, and are willing to make great efforts in their behalf.

The Improvement of Towns in England.

The most important and effective legislation in this direction includes the several laws, both general and special, authorizing the local governments to drain certain wet districts in the country, and to make improvements in the cities. Under the authority of these laws, many towns widened streets and lanes, opened courts, made sewers, paved highways, removed families from cellars, destroyed unfit habitations, swept and washed the filthy pavement, cleared away the middensteads or collections of animal excretion and refuse; they filled low and muddy places, and made these streets and neighborhoods dry,

clean, airy and healthful,—consequently sickness diminished, the rate of mortality was reduced, the average age at death was increased. The people were stronger, more active, buoyant and cheerful; they earned a better sustenance; the numbers of paupers, both in and out of the workhouses, were lessened, and the poor-rates were less burdensome.

The records of very many of these improvements, in various towns, together with the rates of mortality for series of years before they were made and after they were completed, are published, and show that there was good reason for beginning them, and that great increase of health and life followed them.

In nineteen towns the annual mortality, which had been 28 in 1,000 living for years previous to the improvements, fell to 21 in 1,000 for the years afterward. In these towns the average annual deaths were 3,276 less after than before the cleansing of these places. So many lives were yearly saved.* In Macclesfield the average longevity was increased 20 per cent. by these means.† In Liverpool the rate of mortality was 38.4 in 1,000 before the authorities made the sanitary changes in the streets, cellars and other dwellings, and 26 in 1,000 afterward.

Latham, in his admirable treatise on "Sanitary Engineering" (p. 10), quotes the results of the improvements in twelve towns, of which the following are the most prominent:—

TOWNS.	DEATHS IN 1,000.		Saving of Life—per cent.	REDUCTIONS—PER CENT.	
	Before Improvement.	After Improvement.		Typhoid Fever.	Consumption.
Cardiff, ...	33.2	22.6	32	40	17
Croydon, . . .	23.7	18.6	22	63	17
Merthyr, ...	33.2	26.2	18	60	11
Newport, . . .	31.8	21.6	32	36	32
Salisbury, . . .	27.5	21.9	20	75	49

These sanitary improvements, in these and in many other towns, were universally followed by such increase of health

* Cowper in Social Science Transactions, 1859, p. 113.

† John May in Trans. Social Science, 1857, p. 403.

and strength, and such reduction of mortality, that Mr. Chadwick, formerly secretary of the National Board of Health, says that a sanitary "engineer ought to contract for the reduction of the sickness and death-rate, in such a city as Glasgow, by at least one-third for a penny a head of the entire population." * The same good results followed the draining of country districts, in some of which the annual deaths were reduced from 2.6 to 2.1 per cent. of the population.

The whole of this experience in many cities and districts, in Great Britain, abundantly proves that the way is open in this sanitary field for the interference of the government, and the reward, in the increase of life and strength, is very great and sure.

The sanitary dangers in the country are due, in great measure, to natural causes, wet and marshy ground, unhealthy dwelling sites, etc. But in the cities they are mostly due to the faults of the people, to bad engineering, bad arrangement of streets and courts, and worse habits of the inhabitants of the foul districts, and to the neglect of the local authorities.

As, in all the civilized world, cities constitute so large and increasing element of the nation, and as there is a tendency of the poor, ignorant and careless to crowd together in the pestiferous centres, it is the duty as well as the interest of the government to exercise an unceasing vigilance to prevent the establishment of such unhealthy conditions of street, court and house. And, if unhappily they already exist, the necessity is imperative that the authorities redeem the people at once from their destructive power.

Growth of Cities.

Here in the United States, as elsewhere, is a constant tendency of population to gather in dense masses. The cities absorb the young and middle-aged from the country, and grow at its vital cost. In Massachusetts towns with 10,000 and more inhabitants held 6.8 per cent. of the whole population of the State in 1800, 22 per cent. in 1840, and 48.7 per cent. in 1870.† The rate of increase of population of the cities and of the rest or country part of the State was :—

* Social Science Transactions, 1866, p. 580.
† Calculated from the census.

	Cities.	Country.
1800 to 1820, . .	18.7 per cent.	4.4 per cent.*
1820 to 1840, . .	110.9 "	20.4 "
1840 to 1860, . .	109. "	45. "

Mortality of City and Country.

The cities not only grow at the cost of the country, but they exhaust human life more rapidly. Sickness is more prevalent and fatal in the dense than in scattered populations. In England, among the same numbers of people living in the towns than in the rural districts, the deaths were many more from every class of diseases except two in the towns than in the country (from the class of zymotic diseases supposed in great proportion to be due to removable causes). They were nearly twice as many in the dense as they were in the scattered population. The proportion of deaths from old age, which are significant of health and longevity, were 37.7 per cent. greater in the country than in the great towns. Of the whole ninety-five causes of death specified in the Registrar-General's Report, only fourteen, and these among the least destructive, were more prevalent in the country.

From the whole number of diseases the deaths were 40 per cent. more in town than in country, or as often as 100 died in the rural districts 140 died among the people of the cities.†

Tables in the sixteenth and supplement to the twenty-fifth reports of the registrar-general show the ratio of deaths in each of the six hundred and twenty-three registration districts and the density of the population, for twenty years. It is seen from these, that the death-rate keeps almost constant pace with the increasing density. In the most crowded districts, where 250 live on one acre of ground, one in eighteen died; and in the country, where there were twenty to thirty-eight acres to a person, the death-rate was one in sixty-two.‡ Similar statements are made in the thirty-four annual reports of mortality.

The report of Mr. Chadwick on the sanitary condition of the laboring classes in 1842, the report of the health of towns

* Calculated from the census.

† Condensed from Registrar-General's English Reports.

‡ Supplement to Registrar-General's 25th Report, p. xxxviii.

commission in 1844, the reports of the Board of Health,—all confirm the statement that vital force is developed in a lower degree, and sustained in less vigor, and that life is shorter in the city than in the country. Both British and French army authorities state that a much larger proportion of the recruits for the army were rejected for want of strength, constitution or sufficient height among those enlisted in the towns than among those that came from the country.

A lower physical vital power generally characterized the civic population of Great Britain and in the foul spots the depression was very great, sickness was abundant and life very short.

American Cities.

These pestiferous centres of disease and death are not peculiar to the old cities of Europe. We have them here in this newer country. The board of health discovered and revealed them in New York. Dr. Draper found them in Boston, and even in some of the little cities of Massachusetts, that within a generation were open country villages. These need the vigorous arm of the law to purify them and make them fit for the residence of healthy and strong men and women.

Government should Prevent the Creation of Unhealthy Districts.

The law now authorizes and commands the boards of health to make these reforms, at any pecuniary cost, for human life and strength are not to be weighed in the same scale with money. If the government can reform the unhealthy districts, remove their causes of sickness, open them to the fresh breezes of air,—if it can overcome these destructive influences after they are established, it can prevent them. If the law can upturn old and corrupted districts, and lay them out anew, favorably for health, it can lay them out according to this plan, when the fields are open, before the population gathers upon them.

The health of towns commission appended to their great and valuable report, a series of propositions for the plan of all new cities, and the extension of all old cities. They required that all these should be laid out, measured, graded,

by a sanitary engineer, with strict reference to the health and power of the people that dwell on them.

It would be a blessing to every city, and economy to the body politic, to make these conditions a necessary element in the organic law of every prospective city; to require that its whole plan of streets, lanes, courts, and open grounds be made by such a sanitary engineer, and be ever afterward under his control. This would prevent the growth of those centres of disease and death, and those condensed hives of feeble population that now infest the old cities, and cost the municipalities so much to improve. This is legislation in the right direction, and at the right time, where it will be most effectual. It offers to humanity protection against its sanitary foe before it appear, and disarms it of power to do injury.

The Law should make Streets Safe for Dwellers as well as for Travellers.

The law already takes the streets under its care so far as to make them safe for the passage of travellers, teams and merchandise. It makes the municipalities responsible for all damage that may befall man, beast, wagon or freight, from defect in the pavement or hole in the highway.

If the law can secure safe passage for travellers, carriages, merchandise in the thoroughfares, and make the towns liable for any damage to limb of man or beast, or to vehicle or freight from holes or obstacles in the highway, it may, with better grace, make the municipality liable for all suffering, fevers, dysenteries, withering of life and strength of the inhabitants, caused by pestilential emanations from the filthy pavement or sloughs in the passage-way. If the town be required to make the street wide and open enough for the passage of carts that bring coal and provisions, it may with more advantage to the families and the public, be required to make them sufficiently broad and permeable for the fresh air to reach and bring health and vigor to the dwellers on the border. The suffering, the loss of power from diseases which the exhalations from the uncleaned ground of these slums generate in the families that live in the houses near to them, are far greater, and cause more loss of time and productive

energy, than all that comes from injuries caused by physical imperfections in the street, lane and court.

Interests of Human Life should hold Precedence in all Legislation.

In as far as human life is more important than all financial interests, and even in the financial view, the creative power of human force is more valuable than all created capital, this cardinal interest of the people, individually and collectively, should take precedence of all other provisions, in all legislation. Every law, grant, or privilege from the legislature should have this invariable condition : that human health, strength or comfort should, in no manner or degree, be impaired or vitiated thereby.

When the legislature grants the right to build a dam, and flow the waters of streams and ponds, the grantee is held responsible for all the damage that may be caused thereby to lands, crops and other mills. All this is well, for these may be compensated in money; but besides this, he should be held responsible that no damage shall be caused to human life and comfort by the changes in the condition of the waters. This cannot be compensated by money.

Factory Villages.

Beside the large masses of population that are gathered in cities, there is a great tendency, promoted by civilization and increasing wealth and industry, to gather people in compact villages for manufacturing purposes. For the convenience of access, and to save time, they live as near as possible to the place of their occupation. Hence the dwellings of the operatives and the boarding-houses are often closely crowded in narrow streets, lanes and courts, and near to the water, sometimes on damp ground; and, to enable the workfolk to live at as little cost as possible, these dwellings, in both village and city, are made to contain many lodgers, with little breathing-space.

In Mr. Chadwick's report on the sanitary condition of the laboring classes, he states that though the operatives suffered sometimes from the close and impure air of factories and shops, they suffered more from the closeness of their homes, and

the impurities of air and ground in and around them. Some manufacturers take extraordinary pains to make their factories, and the dwellings and boarding-houses of their operatives, airy, healthful and invigorating. The Pacific Mills, of Lawrence, Mass., offer a noteworthy example of this sanitary arrangement, and find good return in the small amount of sickness and loss of time among their people.

The silk factory at South Manchester, Connecticut, in which about a thousand people are employed, is situated in an open field of about five hundred acres. The halls, the rooms of the great factories and the shops are large, open, well ventilated and lighted. Everything about them is enlivening and cheerful. The dwellings of the operatives who have families, and the boarding-houses of the others, are spread about on the lawns, separated from each other, with open grounds all around them. Everything is comfortable and attractive and tends to promote vigor and working power. The proprietors find that their benevolent and sagacious provision for the health and happiness of their work-people is well rewarded in their more constant strength, clearer brain, and more controllable and effective muscles. They do more and better work; consequently, all connected with the establishment are more prosperous; the company make larger profits; the men and women earn more money; and all add more to the income and capital of the State.

The English laws offer many securities for the health and safety of the operatives in factories, and vigilant, ubiquitous inspectors watch closely for the sure fulfilment of these regulations. The law of Massachusetts defends children from suffering from too early employment and excess of work in their tender years in these establishments, lest they be blighted in childhood and grow up to feeble and ineffective manhood and womanhood, and unprofitable members of the Commonwealth.

The same humanity and public interest demand that the State protect these working-people, both young and old, at their homes, from the wasting influence of bad, damp, unhealthful locations and surroundings, from foul and pestilential streets and grounds, from noxious emanations sent forth from decaying material and artificial accumulation of waste matter.

Such sanitary provision should be made a necessary element of every law that incorporates manufacturing establishments. It should be made to reach and govern all collections of people, whether in city, town or village, whether for business, labor or dwelling purposes. In this way the State would take the first step to insure that every plan, enterprise and movement shall be begun and conducted without needless cost of human health and force, and without depreciation of the productive power of the people. In this way all legislation would hold first in consideration the Commonwealth's greatest interest,—the power of the people to create value and capital.

Legislative Sanitary Committee.

Our legislature always has various committees, consisting of men selected for their special intelligence, to watch over the several classes of public interest and see that they suffer no damage, and, more than this, to see that they derive the most advantage from the parental wisdom, care and power of the government. There are committees on education agriculture, manufactures, banks, insurance, finance, fisheries, railroads, mercantile affairs, towns, etc.

The New York legislature adds to these a committee on public health.

Such a committee, here and elsewhere, would find plentiful occupation in watching the effect of all laws on human health and productive force, in searching for causes of injury and the means of their removal or amelioration, and in providing securities for the future.

Manner of Legislative Action.

As a drowning man, or a child falling into the fire, demands help, prompt and energetic in proportion to the imminence and degree of the peril, so some sanitary dangers demand the immediate and efficient interference of the law, only to be measured by the importance of the matter that is at risk. When a person tampers with human life by adulterating food, or knowingly and selfishly offers to sell unwholesome articles of diet; when he reduces milk with water or adulterates it with foreign matter, and thus deprives children and adults of their due nutriment, or impairs their stomachs with indigesti-

ble mixtures; when men thus selfishly sacrifice the health and strength of others for their own gain, the law should hold this as a crime, as when one robs another of his property, or impairs his life and power with deadly weapons, and relax none of its severity until the destructive practice is overcome and the people assured of safety whenever they purchase milk or other provisions in the market or elsewhere.

In all cases where life and health are in question, the arm of the government should be used with sufficient force to protect them. A few years ago there was a very large establishment for boiling dead horses in the neighborhood of Boston. The flesh, with swill brought out of the city, was given to several hundred hogs in a piggery on the grounds. The odors from the processes and the hogs were very offensive to the neighborhood and injurious to their health. The town board of health remonstrated without effect. They complained to the grand jury. The proprietor was indicted for keeping a nuisance. The case was manifest and could not be denied. But he knew the mildness of the law and the limit of the penalty. Weighing this against the profits of the business, he let the case go by default, paid the fine, and continued the work as before. It was more profitable to disobey than to regard the law. The law should not be thus set at defiance nor be bought off. It should never, in these questions of human health, be for the interest of the offender to persevere in his injurious practices.

Fields of Sanitary Legislation.

There are many fields for culture and operation in this broad sanitary region. They are as various as the habits and experiences of the people. The interests of health require unceasing vigilance of individuals in their self-management, and of the government in its watch over the conditions and influence that may affect them for good or evil.

Nutrition.

Animal life is maintained by a constant change of particles in the living body. We eat and drink two, three or four pounds of solid and liquid food in a day, and yet, after reaching maturity our weight is not materially increased. We

take into our bodies about a thousand pounds, half a ton, in a year, and yet at the end weigh no more than at the beginning.

Our food, or whatever proportion of it is soluble in the digestive organs, is converted into nutriment of the blood, and whatever proportion of this is fitted for its ultimate purpose, is converted into flesh of various kinds in the several textures of the living body. The atoms of digested food thus become parts of the muscles, skin, fat, stomach, lungs, brain, nerves, bones, etc. When deposited in their new places, they are endued with the principle of life and with the peculiar and specific living powers of the organ or part to which it is attached; in the muscles they contract, in the nerves they feel, in the brain they perceive, in the skin they receive impressions. In their several positions and connections they act and serve the purposes of life for a short period, and then they die, and are removed by an appropriate apparatus from their positions and other and new particles are brought to take their places, to live and work for a while and then give their places to their successors. After they die they are carried out of the system through the lungs, the skin, the kidneys and bowels. As much thus goes out as comes into the living body. We are continually passing through a change in our internal structure. We are daily, hourly, momently dying, particle by particle, and as continually revived with the freshness of new life. This is nutrition. For this, new and appropriate materials in form of food must be constantly supplied.

Food and Cookery.

For this renewal of our bodies we ourselves provide the material,—dead flesh, meats, fowl, fish, bread, vegetables, fruit, etc. Nature takes what we offer her, digests it, if it be digestible, and converts it into flesh if it be nutritious. But nature is not indifferent as to the kind and condition of the material that is offered. The stomach will not digest all things alike. The nutritive organs cannot convert all matters into living flesh. The raw material, the food, must be selected in exact accordance with the powers of digestion and its fitness to be converted into flesh. It must be prepared and cooked

in such a manner that the delicate organs of digestion and nutrition can use it for its intended purpose.

This work of the purveyor and the cook, the selection and preparation of our food, requires more intelligence of its purposes and means of accomplishing them, more consideration, careful judgment and discipline, than any process submitted to human supervision.

If the food be appropriately selected and suitably cooked, it is easily digested, and converted first into blood and lastly into flesh, then the body is well nourished and made strong. The eater enjoys a feeling of buoyancy and energy. He has possession of all his faculties, and is ready to apply them to effect his purposes. He thinks clearly. His muscles are ready for labor. His stomach does its work quickly, easily, and he is unconscious of its operations.

But if the food be misadapted, if it be prepared in a manner unsuited to the stomach's power and the wants of nutrition, the eater suffers in various ways and degrees. He may have pains and oppression. The digestive powers may absorb an undue proportion of the nervous energy, and make him feel dull and heavy. His brain may be indisposed to action, and unable to carry on the mental operations. He is therefore more or less unfitted for labor or business, or the food may fail to supply the new atoms of flesh, in due proportion, and then the body is not renewed in the fulness of life, the muscles are not strengthened, the man is not refreshed.

Much disease and disability, much distress and great loss of working power both in body and in mind, and even premature death, are brought upon us in consequence of the misadaptations by the provider and unfitting preparations of the cook.

These, the provider and the cook, are our life-makers. We are in their hands, to make us what they can or will,—strong or weak, buoyant or depressed, active or sleepy, clear, bright, quick-witted, or dull and torpid. No office has such control over human power and effectiveness as that of the housekeeper and the cook. There is none to which the Commonwealth is indebted for so much of its energy.

An office that wields so much power can be filled only by persons of high intelligence, appropriate culture and thorough

discipline. No office offers so wide and rich a field for the exercise of talent and scientific acquirement. No other position offers the opportunity for mind, heart and hand to produce such large and desirable results. It is both a public and private misfortune that this office is not so considered and esteemed; that the intelligent do not seek it, and the ambitious avoid it, and that consequently it is given up to the lower grades of intellect and culture.

In the social and domestic organization of the civilized world, the men do the work and business abroad. They are farmers, mechanics, laborers, merchants, etc. The women are the housekeepers and provide and prepare the materials of life, or appoint those who do this in their stead, and become responsible in their office for the nutrition and thereby for the health and power of the family.

The woman is not, by nature, a housekeeper or cook; nor is the man, by nature, made a farmer, mechanic or trader. But each has the capacity to learn the principles and details of the art or occupation which he or she may elect to pursue. The man fits himself in youth for his future sphere of business, and takes the responsibility of its management only at maturity, after he has strengthened himself with knowledge and discipline for its burdens, otherwise he fails in his attempt. The woman often defers her preparation for her office as housekeeper until she assumes the responsibility, and sometimes she accepts it while yet immature, undisciplined and unformed in character. If outward circumstances favor, she finds some other person to bear the most important part of her responsibility of providing and preparing the family nutrition. Generally this is performed by a deputy of the lower order of intelligence, who has no rational nor clear idea of the duty she undertakes or of the sanitary consequences of her operations.

As a natural consequence of intrusting this all-important matter of human nutrition to such inadequate agencies, the preparations of food are often uncertain and unfitting for their purpose, and it is but a chance that they are adapted to the powers of the stomach or the necessities of the living organism. Hence the common and very apt and descriptive congratulatory remark of the housekeeper, that "she had good

luck with her bread," or the apologetic statement that "she was unlucky with her cake."

A second, but necessary, consequence of the imperfect intelligence as to the responsibilities of the kitchen is, that the family is sometimes oppressed by the labor of digestion and imperfectly nourished, and the final result is, that not unfrequently they are not strengthened for work nor fitted for business, and then their efficiency is impaired and their productive energy is reduced.

Nutrition of Domestic Animals.

Our domestic animals are, and have been, more favored than their owners in respect to nutrition. Public attention is continually called to consider the best methods and means of strengthening and fatting them or fitting them for their intended purposes. So many are carefully studying their wants and the means of supplying them,—so much has been written in books, magazines, newspapers, in society reports and state reports,—such clear, philosophical and practical essays on these topics have been spread abroad by the agents of the government,—that most farmers are familiar with the best way of feeding their horses and oxen to develop their greatest strength for work, their cows to produce the best quality or largest quantity of milk, their cattle and swine to produce the most flesh on their frames,—that, with all these aids, failure in these matters is very rare, while lean, weak, dyspeptic men and women and children are common.

Purpose of Food not Generally Understood or Regarded.

Beside the inadequate nutritive supply for human necessities, there is a frequent lack of intelligence as to the real purposes of eating and the means of completely fulfilling them, and a general contentment with whatever may be offered from the kitchen. The eater's ideal of good food generally corresponds with the caterer's. Although good, digestible, nutritious bread is far from being universal (and it very generally falls short of the best standards in these respects), most people have the very comfortable belief that, at their own homes,

they have good bread, and pity their neighbors who are not so highly favored.

There is also a very common sort of heroism or physiological stoicism in regard to eating. People often say, with self-complacency, that they can always eat whatever is set before them. They seem to think it unmanly or unwomanly to complain of their food. Not denying that they have special appetites, which they may indulge when suitable occasion may invite, yet to be particular as to their diet, and to give trouble to others on this account, appears to them to savor of selfishness and meanness. Their only principle is to fill the stomach with anything that is handy. Thus, while they feed their beasts and fowls, each for a specific purpose,—strengthening, fattening, milking, eggs,—they feed themselves and their families according to the accidental convenience of the purveyor and the cook.

A generous traveller, driving his own team, in cool weather, stops at a wayside inn, at noon, for rest and refreshment. He first cares for his beast. He sees that the horse is unharnessed, rubbed dry with straw, housed and blanketed. He directs the hostler to give first a little water and plentiful hay, and when the animal shall be sufficiently cooled and rested, to add grain and more water. Having done this, he goes into the house and takes such food as can be obtained, without much trouble to the family.

A farmer in Massachusetts, of high intelligence in all the varieties of his vocation, watched all his animals unceasingly. He was familiar with their temperaments, habits and apparent wants, and fed them according to these idiosyncrasies and his purposes concerning them. His working and fattening cattle and milch cows had different food, to promote their different ends. To one horse he gave oats, to another corn, and to a third meal with cut hay, because each worked better with the special kinds of food. He discriminated among his fattening pigs, and gave some potatoes and others meal, because they throve better with these respective diets. Nothing in these matters among his animals escaped his notice or was neglected by his judicious care.

One day, meeting his physician accidentally, in the afternoon, and appearing to be in pain, he was asked as to the

cause. He said that, for many months, he had felt great distress and oppression for two, three or more hours after dinner, so that he was almost unfitted for work, and at noonday this was very severe, so that he usually lost the whole afternoon. He had the same in the morning after breakfast, but it was less severe. The physician inquired minutely as to the farmer's diet, and learned that the only constant article was brown bread (rye and Indian), which he always ate freely at dinner and sparingly at breakfast, and noonday he had Indian pudding. Hence arose his trouble. The Indian meal, which is ordinarily very healthy and digestible food, was not digested in consequence of some temporary weakness of his stomach. It fermented, turned acid, and gas was evolved, and produced distress and general depression. Following the physician's advice, he discontinued this bread and pudding, and had no more pain or debility, but was able to labor without interruption or discomfort.

This careful observer of his cattle and fowls, who ministered to each one's necessities, had not thought to watch himself, nor had he suspected that there would be any connection between his food and his suffering and weakness. He is an extreme illustration of the mental habits of a large part of the community as to their own nutrition and power and those of the beasts that they care for.

Financial Estimate of the Office of the Cook.

The price, in money, in the general market, or the financial value of any service, is a good indication of the world's estimate of its importance.

Less is given to those who prepare our food than for most other service. The wages of a cook are much lower than those of the maker of our garments. The groom that feeds the horses is paid twice as much as the one who feeds the family. The carpenter and the bricklayer, who build our houses, are paid as much for the work of a day as the women that build our bodies for the work of a week.

According to the natural law, the character of the supply rises and falls in accordance with the estimate that is put upon it, and the reward that is paid for it, in this as in other occupations. The talent that can rise high avoids the food labo-

ratory, where it is meagrely paid, and goes to the clothes laboratory, where it is paid generously. The cook of little education and skill in her vocation, finds small inducement of better appreciation or higher wages to cultivate her talents and become accomplished in her art, as men and women in other employments, where respect and reward follow step by step closely upon improvements in taste and workmanship.

Government Aid.

Here it may be asked, What can the government do in this matter? Shall it write a book on diet and cookery for the people? It has caused this to be done for domestic animals. The interesting and instructive State Agricultural Reports are bespread with admirable essays on the food, its material and preparation, for cattle of various kinds and purposes,—working, milch, fattening; and also for swine and fowls. The writers prove the excellence of their teachings in the results of their practice in the production of flesh, strength, milk, etc., and in the increase of vitality. One teacher, in the report of 1872, after describing minutely the material and the manner of the preparation of the food, said that "he had this year raised one hundred chickens without one case of sickness."* He does not say there were no deaths in his flock. But if there were no sickness none could be lost from this cause.

Through all these annual volumes, issued by the State, we find these receipts, directions for the healthful nutrition of animal life, written by the agents appointed by the government or enlisted in the work by its influence. And although these sagacious and profitable teachers have given their lessons of wisdom for so many years, still they are not satisfied with the progress they have made. They are untiring in their investigations and teachings. Every volume is freshly laden with new wisdom, new instruction, as to the means and manner of nourishing animal life.

By the use of similar agencies and instrumentalities, the government can begin, and in course of time accomplish, as large a work in respect to the people, as it has in respect to the cattle. It can create such a public sentiment that those who

* Page 300.

have the care of human nutrition, whether in themselves or in others, will be as eager as the farmers to learn the principles and practice of their vocation, and feel as responsible for the fulness and duration of life in men, women and children as the managers of domestic animals for the health and power of the beings under their charge.

Insanity.

Among the many interruptions to human effort and productive power caused by ill-health, insanity, which includes a wide range of mental disorders, stands prominent by its frequency and persistence. Under appropriate influences, insanity is among the most curable of grave diseases. If the persons who are attacked with this disorder are as promptly cared for as others when attacked with fever, dysentery, pneumonia, etc., 80 or 90 per cent. can be restored to health and usefulness. But if neglected, the disease tends rapidly to fix itself upon the brain, and becomes more and more difficult to be removed. If allowed to remain one year, the chance of restoration is materially diminished. In two years this hope is reduced more than half; and after five years' duration few are restored, and even then it is due to some unexpected turn of the disease rather than the result of healing remedies.

Not only is the chance of recovery lessened by delay of attention, but the time required for cure is greatly increased. The period of the healing power varies with many circumstances and conditions, from a few days or weeks to many years. The average in the several hospitals in this country ranged from ten months and five days in the longest, to five months and three days in the shortest. In the Worcester Hospital it was 23.8 weeks, in the Northampton, 30 weeks, and in the McLean Asylum, 22 weeks; the differences being due, in great measure, to the earlier or later attention to the cases by the friends.

Under the power of this disease, the sufferer not only ceases to be a worker and to contribute to his own support and that of his family and the State, but he is a positive burden, for the cost of his sustenance and the care necessary for him in his wayward impulsiveness and uncertainty

of conduct. He always requires supervision and guardianship. Some are violent, a few are dangerous, many, perhaps most, must be confined, or under the watch of discreet and faithful attendants. This is necessary for their own security and comfort, or the safety of the community.

In the most favorable condition, the cost for care and sustenance of the insane is greater than that of the sound in mind, and with most, the expense is very much greater.

Although insanity unfits its subjects for mingling with, and taking part and lot in the interests of, the world, it is not immediately destructive to life. Some lunatics live five, some ten, others live fifteen, and a few live forty and fifty years, while suffering from their mental malady.

Mr. John LeCopelain, actuary of the Albion Life-Insurance Company, in London, calculated the average longevity of the insane at the several periods of life, and determined the number of years that they would live after any age from twenty, thirty, forty, etc. This life-table of the insane in England compared with the life-table of the sane people, shows how much life is lost by uncured insanity.

The following table includes the mean number of years that the insane and the sane in England will live after specified ages, according to the LeCopelain Table and that of the English Life-Table by Dr. Farr:—

Years of After-life from Ages.

AGE.	MALES.		FEMALES.	
	Sane.*	Insane.†	Sane.*	Insane.†
20, ...	39.48	21.31	40.29	28.66
30, ...	32.76	20.64	33.81	26.33
40, ...	26.06	17.65	27.34	21.53
50, ...	19.54	13.53	20.75	17.67
60, ...	13.53	11.91	14.34	12.51
70, ...	8.45	9.15	9.02	8.87

* English Life-Table, 1864, Dr. Wm. Farr, p. cli. † Mr. John LeCopelain's letter.

It is seen from this table, that men twenty years old becoming insane, will have an average life of 21.31 years, if not restored to health. During this period, their families and the

Commonwealth not only will lose their services and contribution to their income, but they will be obliged to support them, at even greater cost than if they were in good mental health. On the contrary, if they be restored, they will have an average life of 39.48 years, during which they may labor for their own and their families' support, and add to the public income and capital.

Cost of Restoring the Insane.

The cost of supporting the patients in the three state lunatic hospitals of Massachusetts, was about four dollars ($4) a week, in the last reported year. The average time required for restoration is twenty-six weeks. Thus the average cost of restoring an insane person in our state hospitals is one hundred and four dollars, and a patient restored to health goes forth to the world. He has then an average life of 39.48 years before him, to labor for himself and the body politic. As merely a common laborer he can earn, at least, thirteen dollars a month, or one hundred and fifty-six dollars a year, beside his sustenance.

If then he be not restored, he remains an unproductive burden on the private or the public estate of the Commonwealth, a consumer of his part or other people's earnings for 21.31 years. At the lowest estimate, for the poorest and cheapest, this cost of board, clothing, care and rent for a lunatic, is three dollars a week, or one hundred and fifty-six dollars a year, which must be paid out of his own or family's estate, or the general treasury, weekly, monthly or yearly.

On the other hand, if he be restored to health, he will contribute as much yearly or weekly to the general income of the Commonwealth.

Here are the means of comparing the advantages and disadvantages of properly caring for and healing the insane and of neglecting them.

On one side is the cost of supporting a lunatic in the hospital for twenty-six weeks, the average period of cure, at four dollars a week—one hundred and four dollars in all. Even if we add for the cost of rent or interest on the value of the hospital, house and lands, etc., thirty dollars for each patient for his six months' occupancy, the whole average cost

amounts to one hundred and thirty-four dollars for the expense of restoring a man from being a profitless burden and making him a profitable coöperator in the community.

On the other side, if not restored, the community, or its members or its estates, becomes responsible for the payment of his board and support for 21.31 years at the lowest rate of one hundred and fifty-six dollars a year, and also loses his earnings of the same amount for 39.48 years.

These two annually recurring sums, each of one hundred and fifty-six dollars, are practical annuities; one, for the lunatic's support, must be paid by the State or its members for 21.31 years; and the other, the earnings which he would have gained for 39.48 years, is lost to the same parties.

At five per cent. interest of money the annuity of the earnings, one hundred and fifty-six dollars for 39.48 years, can be bought of an annuity company for twenty-six hundred and sixty-five dollars and thirty-seven cents ($2,665.37). This is the present commercial value of a laborer twenty years old.

The annuity of the cost of the support of the uncured lunatic for 21.31 years can be bought for twenty-one hundred and forty-one dollars ($2,141). An annuity company will contract to pay this sum for this period for this amount. This is the present worth of the obligation resting upon the State or its people for the support of a neglected lunatic, beginning in his twenty-first year.

The costs and the profits of healing lunacy may then be compared in the cases of laborers becoming insane at twenty years of age.

Gain, present value of his future labor,	$2,665 37
Present value of the cost of his support if not healed, ...	2,121 00
Total saved and gained, . . .	$4,786 37
Cost of healing, ...	134 00
Net gain, ...	$4,652 37

On an average, a lunatic twenty years old, allowed to remain unhealed, entails a loss of $4,786 to the body politic and a gain of $4,652 if restored to health.

If the patient be older, with a lesser duration of life before him, whether insane or restored to health, the cost and the loss will be proportionably less.

In the foregoing calculation no regard is paid to the ten or twenty per cent., who, from the nature of their malady, cannot be healed ; upon whom all hospital skill and efforts will be expended in vain. These must be supported in the period when the trial of remedy is made, either in the hospital or at home, and the cost in the institution is but little if any more than it is elsewhere. And considering the great burden of a lunatic in domestic life, the care and anxiety, the interruption to business, the lessened labor and production caused by his presence, it is safe to say, that the average cost of supporting and caring for the insane in private families is as great as it is in the state hospitals.

The example quoted above is that of a common laborer, without skill, trade or profession, who earns thirteen dollars a month beside board, and whose board is three dollars a week. Mechanics, merchants, proprietary farmers, professional men, etc., earn much more, if in health, and live at greater cost, if mentally diseased. They are worth more, the loss is much greater if their malady be not relieved, and the gain greater if they are restored.

Economical Practice in some States.

Several of the Western States, looking upon insanity in this economical light, and believing that for the good of the commonwealth as well as for the sake of humanity, every mentally diseased citizen should be restored to health and usefulness, at any cost, open their hospitals gratuitously and bid all their families to send their lunatic members to be cured with the least loss of time or productive power.

They find the double advantage that a much larger proportion of these patients are sent in the early and curable stage of their disease, and a larger proportion are restored, and consequently a smaller proportion are left in permanent lunacy, a life-long burden on the public or private property of the commonwealth.

Burden of Insanity in Massachusetts.

When the insane of Massachusetts were enumerated in 1854 there were 2,630 in the State. Of these 2,007 were American and 625 were foreigners. Eight hundred and twenty-four, or 41 per cent. of the Americans and 16 or 2.5 per cent of the foreigners, had never had opportunity of healing in a hospital.

If the proportion of the insane to the sane population continued to be as large, there were 3,194 in 1870, and there are still more at the present time. In 1854 there were 2,018 or 76 per cent. incurable, 435 or 16 per cent. were curable, and nothing was learned of the prospects of 179. The incurables were those who had not been in any hospital, those who were not sent until their malady was immovably fixed, and lastly, those who had had an appropriate trial of the healing process, but whose disease was incurable from the beginning. Some of those, who, in 1854, had never been in a hospital, were diseased past cure before the Worcester hospital was opened, in 1833. Most of these probably have passed away, and that class is reduced. A larger proportion of lunatics are now sent to hospitals, and more of these are sent in the early stages of their disorder. Still, many are kept back until their day of healing is past. Of the 1,019 admitted last year into the state hospitals, 489 had been diseased a year, and 391 two years or more. The great majority of the last must remain insane for life.

There is no record to show whether any, or how many, were deprived of all opportunity of treatment in the state hospitals. According to the last reports there were 1,006 paupers and 298 paying patients belonging to Massachusetts in these establishments. Adding the lunatics in the McLean Asylum, the asylum at Tewksbury, and the receptacle at Ipswich, there were 468 independent patients and 1,533 pauper patients in the institutions of this State. Beside these, the overseers of the poor reported 442 others in almshouses, etc., making 1,975 reported pauper insane in the State. It appears, then, that this class of patients are sufficiently well provided for.

But the 468 independent patients under care indicate either that the self-sustaining families enjoy a remarkable immunity from mental disease, or, more probably, that but a small proportion of their lunatics are sent to the hospitals and a large proportion retained at their homes.

As the self-sustaining families are as anxious that their insane relatives should be restored as the poor, it is worth while to inquire why so many of the latter class and so few of the former are found in the hospitals.

The established charge in the state hospitals for private patients is five dollars ($5) a week, and more when circumstances permit.

A large proportion of the independent families, in this and all civilized States, earn a comfortable living only, and have no surplus. By diligence and good discipline of economy they have sufficient for all their common wants, and no more. To them the payment of two hundred and sixty dollars a year, for the support of a member in a hospital, is nearly or quite impossible, and certainly a burden painful to be borne, and especially if that diseased member be one of the heads, who creates or administers the income. This class embraces professional men,—especially clergymen and teachers,—small farmers, mechanics, journeymen, small traders, etc., who constitute no small proportion of the people, to whom, or, at least, to many of whom, the state hospitals are practically closed by their inability to pay the appointed charge for board and care.*

From these and other causes, we have, in Massachusetts, about 3,300 lunatics, who are and must be supported at an average expense of three dollars a week, at least, for each, or $514,800 a year for all. Add to this the loss of their earnings, and the whole cost of the burden of insanity approaches a million dollars annually in Massachusetts.

* Three unmarried sisters sustain themselves and, in great part, their aged parents, by their personal labor; one taught school, one is a book-keeper, and one a saleswoman in a store. Three years ago one of them became insane. They applied to one of the state hospitals for admission, stating their pecuniary condition. They received answer, that the patient could be received for five or ten dollars a week. They could not spare five hundred and sixty dollars a year, nor even two hundred and fifty. They could not call themselves paupers and apply to the overseers of the poor. The patient was not sent. She is now insane for life.

Constant Recurrence of Insanity.

The causes of insanity are many and various. They inhere in the constitutions of some. They are connected with many physical disorders and forms of vital depression. They grow out of perversions, excesses, abuses of the mental, moral and bodily powers, especially the appetites and lower passions. These vary in different periods, and with different people, yet in any population their united destructive force is about the same from year to year.

The number of patients admitted to the hospitals, within any year, may be assumed to represent as many new cases of the disease. For although in the last year, and in the preceding year, many of the lunatics received had been diseased one, two, five, ten and more years, they left behind as many, who will be presented to the hospitals when their maladies shall have been standing as long. Taking thus the annual admissions into the hospitals of Massachusetts as representatives of the number attacked, there was an annual average of 953 new cases in the last six years, or one in 1,508 of our people were stricken down with insanity in each year. The proportions to the population were singularly regular in these six years,—1867 to 1872,—being severally one in 1,546, 1,486, 1,533, 1,350, 1,389 and 1,357. There was a similar regularity through many preceding years. During the war the proportion was less. The opening of each new hospital increased it.

What has been will be, in the same conditions, unless our personal habits and exposures and our social customs change. A similar proportion of our people will annually become insane. And unless more effective influences be used to induce their friends to use the proper means of healing, or to draw them into the hospitals in the early and curable stage of their malady, a like proportion will be kept at home until their disease is fixed beyond hope of removal, or deprived entirely of the opportunity of being restored, and be life-long burdens on the body politic.

With this experience of the past, with this great and increasing burden on the income and capital of the people, considering how small the cost of restoration and how large

the cost of neglect, it is good economy for the State to open its hospitals freely to every lunatic, and even compel every one to use these or other appropriate means for healing, and allow none to remain permanently insane except the small residuum whose mental disorders are, in their nature, incurable.

Humanity as well as economy still further demands that the government lend its intelligence and its influence to discover the causes of mental disorder, and to lead the people from those paths of error and those pitfalls that have hitherto destroyed so many among them.

SCHOOL HYGIENE.

By FREDERICK WINSOR, M.D., of Winchester.

SCHOOL HYGIENE.

In 1870, the population of Massachusetts was 1,457,351. It may fairly be estimated to have increased to 1,500,000, up to the close of 1873. In 1872, there were in the 5,198 public schools of the State, 276,602 children. Add to these the number of pupils in the incorporated academies and the private schools (17,952), and we have an aggregate of 294,554 pupils at school. That is to say, *more than one-fifth* of the population are at school, and subject to the physical as well as the mental influences of school-life. To investigate the hygienic influences of this occupation of school-going, and offer suggestions as to the means of improving these influences, is the purpose of the present paper. No subject within the scope of the investigations of the Board of Health can be of greater importance to the State or of more vital and anxious interest to every family in it, and since the public interest in the schools is so warm, and the public assurance of their immense value is so complete, as to cause a natural jealousy of any criticism of them, lest it should prove a cover for an attack on our school system which might in some way impair its usefulness, it may not be inappropriate at the beginning of this inquiry to state that there is about it nothing of hostility, and that its aim is to make an impartial investigation. Like every other occupation, school-going must have its liability to peculiar hygienic disadvantages. Let us seek to discover these, and also the means whereby they may be reduced to a minimum.

It must be considered, that this one-fifth of our population whose occupation is under investigation, are all in the growing, formative, susceptible stage of life, not only most readily, but most *permanently* affected by every influence to which they are subjected. Without doubt, the instinct of childhood

is for frequent, almost constant, change of position and interest during the waking hours, and any steady occupation within a restricted space, may be fairly termed *unnatural* for children. But since the vast majority of children cannot have an "education," without some degree of violation of what may be termed the normal conditions of childhood, and since some education is a necessity, it becomes of the first importance to maintain a constant, jealous watch over the health of school children, and to persevere in the attempt to harmonize school methods and influences with the healthy instincts of childhood. Confinement, vitiated air, enforced quiet, prolonged mental effort, the use of the eyes on small objects in trying arrangements, are all, *in some degree*, conditions necessary to school, but threatening danger to the health of the scholars. To reduce this to a minimum, and there maintain it, is a public duty.

If this could be accomplished at once, there would still remain a host of injurious influences which are acting on children when *out of school*, and for which the schools are in no way responsible. Disease, whether preventable or inevitable, poverty, ignorance, dirt, at one end of the social scale; luxury, fashion, social dissipation and amusement, at the other end,—all these are harming the health of the children of Massachusetts, far more than any school influence. But *the consideration of these evils is not within the scope of the present paper*, and they would not be mentioned here, except from the desire to avoid misapprehension. All that is attempted here, is a contribution to the subject of school hygiene.

No claim to originality is made in this paper. There is probably no suggestion in it which has not been previously made elsewhere. But it does combine and compare the testimony of a large number of new witnesses with that which was previously at our disposal, and attempt to put the gist of the whole into a shape that may prove a contribution of some practical value to the solution of the hygienic side of the school question. What was the method taken to obtain the fresh testimony, will appear from the following circular. It will be observed, that it calls for replies based on *personal observation*. Nine-tenths of the answers were returned before October 1st, 1873.

The list of "references" given at the end of each division of the paper, although very incomplete, is offered as likely to be of assistance to readers who wish to investigate the literature of the subject in this country. The plan of the paper accounts for the comparative neglect of foreign authority.

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, BOSTON, July 25, 1873.

To Correspondents of the Board.

GENTLEMEN :—The subject of "School Hygiene" is one on which we desire to collect as much information as possible. For this purpose the following questions have been prepared, and we respectfully ask for replies, based upon your personal observation. Any information on this general subject will be received with many thanks.

Replies may be sent at any time previous to October 1st, 1873, to the Secretary of the Board, by whom they will be transferred to Dr. FREDERICK WINSOR, of Winchester, who will give the result of his investigation of this subject to our Board, for publication in our next Annual Report.

In behalf of the State Board of Health,

GEORGE DERBY, M.D., *Secretary.*

1. Is one sex more liable than the other to suffer in health from attendance on school?

2. Does the advent of puberty increase this liability?

3. Is the injury most apt to fall on the osseous, the respiratory, the digestive, or the nervous system?

4. Does eyesight often suffer?

5. What opinion does your experience lead you to entertain in regard to study out of school, in addition to ordinary school attendance?

6. Is a single *long* session different in its hygienic influence from two shorter sessions?

7. Do your observation and experience enable you to separate the hygienic influence of *study* from that of emulation, anxiety about rank, etc. (say of work from "worry")? Also from the influence of confinement, bad air, etc.?

8. Is the occupation of school-going worse hygienically than other occupations in which children would engage if not in school?

9. Have you any opinion based on observation of the so-called "half-time system"?

10. How can our schools be modified to improve their hygienic influences?
   (*a.*) As to tasks and discipline?
   (*b.*) As to physical conditions?

In the number and nature of the replies which have been obtained, we find the strongest evidence of the wide-spread sense of the importance of the questions raised, and the corresponding desire to help in correctly answering them. It is with great regret that we admit the necessity of laying before the public the *results* only of these very valuable replies. The proper limits of the present paper will admit of quoting merely a small portion of that which the parents and teachers of Massachusetts would read with lively interest and profit.

Replies have been received from 160 persons, of whom 115 are physicians; 19 are physicians and members of school committees; 14 are teachers of experience, and six are superintendents of schools.

Without doubt many more than nineteen of the physicians have served on school committees, though there is direct evidence with regard to this number only. It will also occur to all who know New England life, that not a few of these physicians must have taught school while acquiring their education in colleges and medical schools.

Taking up the questions in order, we will, so far as possible, classify the answers obtained and present them in numerical form, giving more at length certain replies which have a peculiar significance, whether agreeing with the majority or not.

The reader who may attempt to make the sum of the various answers tabulated under each question agree with the total of correspondents, or even with the number stated as having answered any one question, will often fail. From the nature of most of the questions a simple "yes" or "no" answer could not be expected and was not desired, and one answer often contains several distinct points of importance. Other replies did not admit of classification. No distinction has been indicated between these *classes* of correspondents, either in the tabulated statements or in the passages quoted, for on none of the questions of the circular did it appear that those of one occupation held opinions as a class at variance with those of another.

QUES. I. Is one sex more liable than the other to suffer in health from attendance on school?

Answered substantially as follows :—

"Females more liable than males," by	109
"Males more liable than females," by	1
"Both alike liable," by	31
"Neither is in danger," by	4
"Not in district schools," by	1
"Not if both sexes exercise alike in the open air," by .	1
"Unable to answer," by	5

One correspondent says, "Girls in the proportion of two to one." Another, "During forty years' practice in the country, I recollect but one instance of a male who has suffered, while I can recall many instances of females."

Quotations from Correspondents.

118. "The female scholars are more susceptible to emotional influences, and if there be stimuli in a school appealing to pride and vanity, they are so emulous as to injure themselves. This is the source of most of the injuring suffered by the scholars in most schools."

80. "Beyond doubt, the girls, from the fact that they *are* girls, are more liable to suffer than boys. In my own experience with both sexes, I found this excess of liability to be very manifest, and I governed my methods accordingly, keeping limitation in abeyance with them, and moderating brain-work and supervising physical exercises. At certain periods I think that study with girls should *wholly cease* for some days. Any one who has taught boys and girls,—in separate schools, I mean,—must have noticed the greater proportionate irregularity of attendance by the latter, and as a parent he would readily know the reason, and know the necessity of cessation from work. I refer to girls between twelve and twenty years of age."

148. "While pleas for lenity to boys on account of feeble health are rare, they are a common thing in connection with the girls."

102. "My pupils were all girls. I gave them more variety of study and less hard labor than boys can bear."

Many others of the 109 express themselves in terms equally strong, some of whom will be quoted elsewhere.

Ques. II. Does the advent of puberty increase this liability?

Answered substantially as follows :—

"Yes," by	120
"No," by	12
"Uncertain," by	9

Of those who answer "yes," many add "for girls," and it is evident that nearly all have the same limitation in mind.

Two call attention to the important fact that at the time of the second dentition children are peculiarly liable to be injuriously affected. It is a fact that many boys, especially those of rapid growth, need a particularly careful hygienic watch at the advent of puberty.

Quotations from Correspondents.

148. "This baleful result becomes very strikingly manifested as the girls approach the age of puberty. Under the abnormal conditions of the physical system produced by this cause, not only do the more emulous and studious girls suffer from the study which they evidently ought to intermit, but the ordinary and habitual task-work necessary to keep abreast of the studies is far too severe a draught on many constitutions. Not a class passes through our high schools, of which some of the girls are not compelled to discontinue a part or all of their studies for a time on this account; and not unfrequently they cease altogether their connection with the school, too feeble to venture a renewal of their studies. The teachers are watchful and considerate in this behalf, but it is scarcely possible to individualize so as to guard against evil results. Little or nothing of all this is noticeable in regard to boys."

80. "It is precisely that advent, and its consequent peculiarity with girls especially, to which I refer, and any trifling or neglect of care in regard to it, is all but unpardonable. With boys the case, under my experience, was wholly different. If they respect and leave innocent God's sacred means of the physical life of our race, their own physical strength will go on increasing, and they will need no other recreative unbending than what they will get from the usual manly exercises of our properly spent vacations; or, under a better system than ours, from union of technic hand-work with mental study."

111. "Girls suffer more than boys from attendance at school. Were, however, the habits of the two sexes the same, in regard to out-door play and exercise, there would probably be no difference between the power of resistance in one and the other sex till the approach of puberty. As a girl draws near this period, menstruates, and becomes capable of child-bearing, the school discipline and work must bend to her bodily needs, in a manner not required by boys. Her menstrual week, one-fourth of her time, or nearly that, must be respected. During these days her mental powers are easily overstrained. The depressing influence of confinement in the school-room, long-continued standing, or even sitting, do her bodily harm. The neglect of these demands of her system, as that of an intended breeder and nurser of men and women, the effort to treat her as though she were a boy, will, in a large minority of instances, do unmistaken harm to those concerned, and eventually to the whole community. Could the custom of keeping girls between the ages of thirteen years and nineteen out of school and at moderate rest during the days of menstruation, become established among us, a certain number might suffer restraint not absolutely demanded, but the general result would be an incalculable gain to the health, present and prospective, of the inhabitants of this Commonwealth."

It is the opinion of more than *seven-tenths* of the correspondents that girls are more liable than boys to be injured in health in our schools, and of *eighty-seven one-hundredths* that this liability increases with the advent of puberty, and to support this opinion, detailed testimony might be quoted from all quarters, both from sources already accessible to the public and from manuscripts. But it is unnecessary. This greater liability in the female is an *established fact*, and our state and local school boards should at once take steps to modify our system of education in accordance with the fact, however great may be the change required. Up to the thirteenth year, identical coëducation is hygienically safe, with the proviso that we make a most cautious use of emulation in all its forms, since at *no* age is it as safe for girls as for boys. After the thirteenth year, girls should not be tasked or disciplined just as boys are. For them, such flexibility should be introduced into the school *régime* as shall fully recognize the feminine law of periodicity, for want of which recognition our high and normal schools and the first classes of our grammar schools are injuring many, and endangering all their female scholars. Were it not that so small a proportion of our school children enter (in Boston, in 1870, $3\frac{2}{3}$ per cent.) and so much smaller a proportion (scarcely one per cent., in Boston) persevere in the high-school course, we should stand aghast at the extent of this mischief. As it is, it falls mainly on those whose school education is carried farthest, to whom we have been accustomed to point as the pride and flower of our common schools. And the numbers of this class are increasing in a proportion much greater than the *general* increase of school attendance. In 1872, the increase of our school attendance was 2,941, while the increase of scholars over fifteen years old was 1,238, more than *four-tenths* of the whole increase. Seven-eighths of our teachers suffer from it, but would suffer far less if they had not been under the same system during the *formative* period of life. That school system which is in harmony with hygiene will recognize not only the law of periodicity, but the fact that throughout the *whole* time between the thirteenth and the nineteenth year the female cannot, with impunity, bear the same *mental strain* as the male.

The principle here insisted on, involves a very great change in our school methods, but by no means an impossible change. Let once the necessity of it be widely felt, and the reform "will get itself made," as has been wisely said. It need not involve a great increase of absenteeism.

References.—Reports of superintendent of Boston schools for last ten years. Reports of superintendent New Bedford schools. Most recent writers on diseases of women or children. "Sex in Education," and various newspaper articles discussing it.

Ques. III. Is the injury most apt to fall on the osseous, the respiratory, the digestive, or the nervous system?

Answered substantially as follows :—

"On the osseous system," by	1
" " " between fifth and eighth year," by	1
" " " before puberty," by . . .	1
"On the respiratory system," by	2
" " " in boys," by	1
" " " after fifteenth year," by . .	1
"On the digestive system," by	1
" " " in boys," by	1
"On the nervous system," by	95
" " " before fifteenth year," by . .	1
" " " after puberty," by . . .	1
"On osseous and nervous systems," by	3
"On osseous, respiratory and nervous," by	2
"On respiratory and nervous," by	14
"On digestive and nervous," by	15
"On neither system," by	4
"Uncertain," by	7

Of those who answer practically "neither," the experience and testimony of one is so remarkable that it should be cited. After answering the first three questions of our circular emphatically in the negative, he states that he taught large schools in one of our country towns from 1809 to 1813, and has since been trustee of a neighboring academy between thirty and forty years, being meanwhile in the active practice of medicine; that while teaching, two hundred pupils were under his care, and while acting as trustee, more than one thousand; yet he "can scarcely recall a single instance of a healthy scholar failing or leaving school from study." Without doubt, this correspondent is to be understood as stating

that in all this long experience he has never known a fairly healthy pupil to suffer from school influences.

Several instances of equally strong testimony on the other side, from persons of equally large experience, might be cited, though not in the same neighborhood.

The following quotations from "correspondents" furnish sufficient explanation of the statistics under Question III. For remarks on the lesson to be drawn from them see Question VII. The first quotation is from the gentleman whose remarkable experience has just been stated.

66. "While children are placed in the lowest and coldest place in the room, the ceilings have been *tossed up* to ten, twelve, or sixteen feet, and hundreds of lives have been lost by these modern *improvements*. Seats should be high, so that a scholar half stands, and can ease him or her self ten times an hour, if he needs, from bearing on his feet or seat, without observation or restraint."

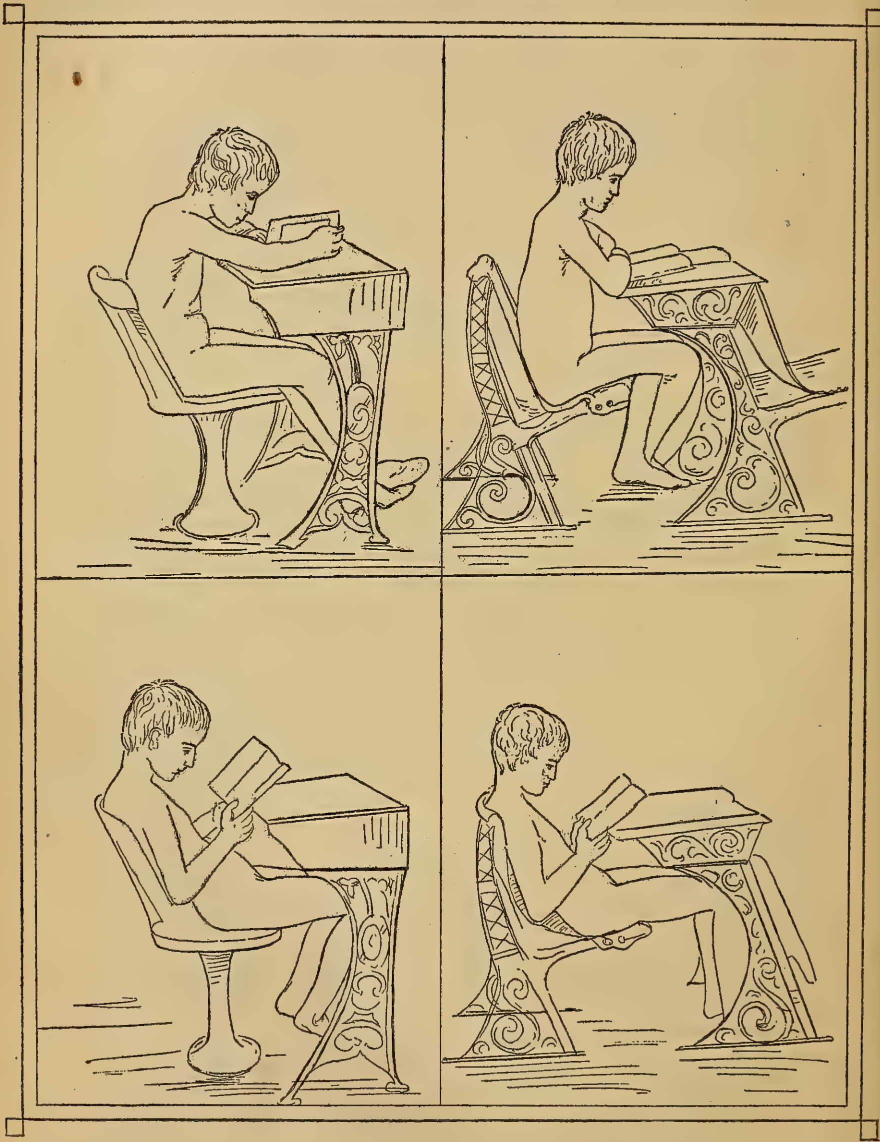
20. "My attention has been directed for several years to the effects of position in schools upon the *spinal column*. I was first induced to notice it in our high-school girls, from the fact that they could be pointed out from grammar-school girls of the same age by their awkward, stooping attitude and swinging step, and I was led to trace it to some cause satisfactory with theory. I found in the high school that the desk was placed so far from the seat, in order that they might have room between seat and desk to stand during recitation, that they could not rest their books upon the desk without leaning forward to study, which fully accounted for the stooping and rounding of the spine and shoulders in six months after leaving the grammar school,—which they did on the average at the age of twelve and a half years.

"After a contention of a year against the objections of teachers and some of the committee, I succeeded in having the desk placed near enough to the seat to allow the pupil to rest the book with ease while sitting erect. And in another six months the effect was apparent in all the classes, as one could select by difference of form those who were admitted before and after the change.

"Now, then, I have investigated the cause of so much awkwardness of position of the pupils while in their seats in the primary schools, where but little care is taken in the making of small seats. In our schools they are but little better than a smooth board, and support only a very small surface (over the tuberosity of the ischium*) on either side and an inch or two of the thigh. This small surface soon grows painful, and then the children fall into all sorts of shapes to relieve the pressure over so small a surface. I then noted some of the common attitudes of the children after they had been in their seats for half an hour or more, and had a measure taken of their legs under the knee (which was done by an instrument constructed for the purpose, so that the whole school could be measured as fast as the figures could well be made), and this compared with the height of the chair. Now, in order to prove the effect upon the muscles, and also to show the curvature of

* Haunch bone.

[Outlines on reduced scale from four of the photographs mentioned on opposite page. The two on the right show the desirable positions.]



spine, a boy of twelve years old, well developed, was selected and photographed, without clothing, in several of these attitudes, thus showing every shade of pressure, and the effects upon the muscles,—not those under pressure, but more particularly those of the cavities, as the abdomen and thorax, and the various curvatures of the spine. A well-arranged skeleton was also photographed, and, to our surprise, the same positions gave the same curvatures as in the boy.

"I then had the same positions photographed in a chair of a different seat and back, and we obtained quite a different result. And we are now putting them into a new primary school, with the hope of giving the school a more comfortable seat and a more uniform attitude, as it admits and *insures* a pressure over a surface at least four or six times as large as can be obtained in a common seat; and a movable desk to rest the book while studying. I should have said that the relative height of the chair for the boy (in taking his picture) was the same as those in school, as near as could be.

"I did not intend to represent a permanent distortion of the spine; but these various attitudes do produce them so long as these attitudes are maintained, and your own eyes will convince you that the glance at the shoulder is proof enough."

If the photographs mentioned by Dr. Burnham in the letter just quoted, and a series similar, but giving other views, together with photographs illustrating the effects of *any* chair and desk when in faulty relations to each other, could be heliotyped and distributed at teachers' conventions, a most impressive practical lesson would be given on the importance of position.

148. "It is, however, the nervous system of the girls which is affected by school influences in a very peculiar and striking manner, far beyond what occurs in the same connection with boys. Delicately sensitive in their organization as compared with the boys, and quick to respond to appeals to their love of approbation, the studious girls are filled with eager emulation the moment that a prize is offered for their competition, or when the ordinary stimuli, active in every thoroughly earnest school, inspire to severe exertion. Their effort becomes painfully intense. They strain every nerve in their endeavors, a restless anxiety meanwhile morbidly preying upon and diminishing their strength. And in those localities where the principle of emulation is systematically and largely employed in the schools, where public examinations, exhibitions, festivals, medals and other details of competitive machinery are ceaselessly exerting a harassing influence, the effect upon the girls must be fearfully pernicious. Many a wreck of health must periodically occur; yes—many a forfeiture of life itself."

80. "Were I of your profession, I might be better able to reply sensibly to this query. My experience leads me to say that the nervous system suffers because of our prevalent forcing method; the respiratory, because of our general neglect, especially in our smaller country towns, of properly constructed school-houses and rooms; and the digestive because of the suffering of these two; while the osseous will not go unharmed if the digestive suffers. Do they not measurably interdepend? The osseous, so far as shape is

concerned, will be badly affected by long-confined sitting in one position, on unsuitable seats, and at ill-contrived desks. Very many schools in this State, notwithstanding its boast and self-adulation, are, in matters of ventilation, heating-apparatus, general school means and facilities, plainly and unexaggeratingly speaking, a disgrace to civilization and a dishonor to Massachusetts. And I am free to say, that were some of the attention now given to push of brain, by our educational supervisors of all degrees in State and town, given to these neglected demands, the brain would not only not lose thereby, but positively gain. In my own private academy, built in 1830, with special reference to all these points, with ample rooms and play-grounds, and supplied with complete illustrative means for every study and personal attention to all that could be required of teacher by pupil or parent, I never knew complaint, or cause of complaint."

QUES. IV. Does eyesight often suffer?

Answered substantially as follows :—

"Yes," by	54
Of whom one says "oftenest in males."	
And another "especially from morning lamplight."	
"No," by	89
"Uncertain," by	13

QUOTATIONS FROM CORRESPONDENTS.

103. "In those of strumous diathesis or those of delicate and nervous organization, eyesight does often suffer; especially if light comes in front and horizontally, and if the child holds the head so as to look downward."

87. "It does, and in those who study by lamplight in the morning, more than those who study in the evening."

65. "Much harm is done by requiring of imperfect eyes the same tasks as those assigned to healthy eyes. And where there is already a certain amount of near-sightedness, its degree is rapidly and dangerously increased by too close and continuous application to small objects."

111. "Setting aside for the moment the demands of the high schools, the use of the eyes in school-work need not, I am persuaded, do any harm, if the ordinary hygienic precautions are understood by the scholars, and their importance appreciated. Even in the high schools, where the extent of work contemplated must always involve a certain amount of risk to the powers of the eye, the degree of harm done is undoubtedly less among us than that reported from schools of this grade in Germany."

The maxim that "*positive* evidence is entitled to greater weight than negative evidence," seems peculiarly applicable to Question IV. Many defects and impairments of vision may arise and increase in childhood without giving alarm to children, or coming to the notice of teachers and parents, if they

are unaccompanied by decided *pain*, as is the case in certain not uncommon injuries to vision. And in regard to the frequency of such cases, we should give a great weight to the opinion of oculists, and of that portion of general practitioners of medicine, whose attention happens to have been drawn to the evil in question. It may well be that other physicians and educators, whose experience covers very few cases of injury to eyesight from school-work, may not have had their attention called to a danger which really threatens many children whom they attend in sickness, because that danger is so insidious. It must be admitted that in civilized nations eyesight was never so taxed as in the present generation, which employs its eyes on small objects near at hand to an extent altogether unknown to its predecessors, and should therefore be correspondingly on its guard against probable mischief to vision.

In order to be able to speak positively as to the frequency and degree to which eyesight suffers in school, we require extended and systematic observations with "test-type," such as have been made in Germany and in St. Petersburg, and reported in tabular form.

By the kindness of Dr. Wight, of Winchester, and of Dr. Abbott, of Wakefield, who at my request made such observations in their respective towns, I am able to offer the following exact though slight contribution to the statistics of this question.

In Winchester, 24 children from a primary school (ages from 5 to 10), as many from a grammar school (ages from 10 to 14), and as many from a high school (ages from 14 to 18), sexes equally divided, were taken in separate squads to a well-lighted hall, where their eyesight was tested with the test-types of Dr. H. W. Williams, and in such a way that one child could not "prompt" another, and with the following result:—

Primary:	12 boys, . . .	1 slightly defective.
	12 girls, . . .	1 short-sighted.
Grammar:	12 boys, . . .	1 very defective.
	12 girls, . . .	1 short-sighted.
High:	12 boys, . . .	2 very defective.
	12 girls, . . .	1 short-sighted—1 defective.

The teachers had been asked to send no child whose sight was known to be defective.

In Wakefield, 24 children were similarly tested in each of seven schools, the sexes being very nearly equally divided; results as follows :—

Primary ($7\frac{1}{2}$ years), 2 very slightly defective, 1 slightly, 2 markedly.

1st Intermediate (9 years), 3 very slightly defective, 2 slightly, 1 decidedly, 1 very.

2d Intermediate (10 years), 1 very slightly defective. 2 slightly, 1 decidedly.

1st Grammar ($11\frac{5}{8}$ years), 6 very slightly defective, 1 slightly, 1 decidedly.

2d Grammar ($12\frac{1}{2}$ years), 3 very slightly defective, 2 slightly.

Advanced Grammar ($14\frac{5}{8}$ years), 6 very slightly defective, 1 slightly, 1 decidedly, 5 very.

High ($16\frac{1}{2}$ years), 4 very slightly defective, 1 slightly, 3 very.

The nine whose sight was very defective were all females. The advanced grammar and the high school rooms are marked "large and finely lighted on N., S. and W."

From the results of thus examining 240 children, I cannot see that any general rule can be deduced. There is certainly no distinct "progressive deterioration." And neither this nor a more extended investigation would be conclusive as regards school influence on vision, unless a similar set of observations conducted among young "workers" could be compared with it.

But while awaiting the results of systematic investigations, we should without delay attend to providing sufficient light, excluding glaring light, and so placing desks with relation to windows that the light may come from behind *and* from the left so far as possible; and always somewhat from above the level of the head, in this way avoiding dazzle, and also the darkening of book and slate by the shadow of the right hand and arm. Finally, the teacher should observe the instances of defective vision, and seat the unfortunate near wall maps and charts.

A word of caution in regard to the effect on the eye of the heat given off by artificial lights. This is much greater in amount than is usually supposed, and of course affects the head and eyes of one who studies with his light near his head, causing congestion and rendering the eye incapable of as much work as it can do, if care be taken to screen the student's

head from this heat; or, better still, that the light should come from the distance of a few feet *above* the head.

References.—See reports of Mr. Harris, Superintendent St. Louis schools, for remarks on lighting school-rooms; also, "Atlantic Monthly"; Injurious Influence of Schools, by Virchow, translation (pamphlet); "American Education Monthly," November and December, 1872; "New York School Journal," July 26, 1873; "Atlantic Monthly," 1871; articles by H. W. Williams, M. D.; also, translation by Dr. Williams of Dr. Kampf's "Causes and Prevention of Near-sightedness," 1871; "Conditions of Health in Schools," Dr. Otto Williams (Leipsic and Cologne, 1871), for this and for the general subject.

Ques. V. What opinion does your experience lead you to entertain in regard to study out of school, in addition to ordinary school attendance?

Answered substantially as follows:—

"Adverse," by	79
"Adverse below high school," by	9
"Adverse unless under careful watch," by	5
"Adverse below 12 years of age," by	3
"Adverse below puberty," by	1
"Adverse for girls," by	1
"Adverse below 10 years of age, and for more than one hour after that age," by	1
"Favorable," by	20
"Favorable if there is but little *study* in school, and rank is not a prominent consideration," by	8
"Favorable where there is a single short session," by	1
"Favorable in intelligent families," by	2
"Uncertain," by	11

Analysis of Above.

Practically adverse,	90
Adverse below high school,	100
Practically favorable,	20
Uncertain or strongly qualified,	17

29. "It seems to me wrong to *require* it in all cases. If our school system could be so pliable as to *allow* it in some instances, to *require* it in others, and to *forbid* it in others still, we might hope to attain the right results. That can be done only in small schools, I suppose."

82. "The opinion that I have thus formed is, that some scholars are able to study one or two hours in the evening besides the six hours in school, while others are not, on accouut of lacking natural vigor of constitution."

87. "My opinion, from experience, is that scholars may study out of school, in addition to ordinary school attendance, say two or three hours, with impunity; if they study from seven to nine or ten in the evening, and spend the

morning in exercise in the open air, or where they can enjoy its healthy influence until school hour arrives, they will be better prepared to perform the duties of the day to their own profit, and their teachers' satisfaction. The memory retains that which is learned with moderation longer than that which is learned in haste and recited in a hurried manner, as is usually the case when all is performed in school hours."

110. "It may be made beneficial, even in a physical point of view. The school-room is not the best place for study. A task can be accomplished better, and in less time at home, when the scholar can be free from the many distractions of the school routine and its harassing effects. Would it not be profitable to review and recite lessons principally at the school building, and make the first thoughtful preparation of them in the comparative quiet of home? Certainly it would, if the parents were at all educated, and could be brought to interest themselves to see the lessons learned, and to aid the children in solving the little knotty questions."

111. "Children under six years old ought not to attend school, unless for pure object teaching, or the work of the Kindergarten, so called. Children under nine years ought not to have more than three hours of school duty, in any form. Above nine years, I see no harm in giving to a child of fair bodily and mental power, a home lesson which will require half an hour in addition to the work done at school. Boys between fifteen years and nineteen, cannot get an education worth having without studying many more hours than the five usually spent in school; and cannot, without serious loss, put off the work of these years to a later period. In every instance, the effort to gain all this, implies some mental and bodily risk. Even boys of fair strength and capacity, need to be sedulously protected throughout the whole continuance of this strain upon their powers by systematic gymnastic exercises, and by securing for them regular hours of unrestrained play."

118. "I believe, that with studies judiciously alternated, so as to call different classes of faculties, with different degrees of demand on severe application into alternating requisition, six hours in school, and from one and a half to two hours out, are none too much for scholars over twelve years of

119. "Often I see pale-faced boys and girls carrying home an armful of books, who have not in their homes convenient places for study; one room only in the house is heated, and that one in which all the work is done,—kitchen, sitting-room, nursery, all in one, illy ventilated, full of impure air."

148. "I will ask your perusal of what appears on the 44th, 45th, 46th and 47th pages of the Report of the New Bedford Superintendent for 1872."

80. "I have always been opposed to it, though the general custom of my day led me into it. I saw no reason why the scholar should not measurably suffer, when I knew that I, the master, did, when I was in the habit of studying from five to seven hours out of school, after teaching six or more hours in school. Nothing but a vigorous constitution carried me through it. I permit it now, for a short time, in a grandchild in my own family, only that I may aid her over some difficult work. As a system, I cannot approve it, and were our teaching what it ought to be (in general) it would not be necessary."

Among the arguments adduced to prove that children are not overworked who study at home as well as in school, is the statement that, in reality, less than one-half of the nominal school hours are spent in real *study*, *i. e.*, learning of lessons, the rest being given up to recesses, recitations, exercises in drawing, singing, calisthenics, etc. It seems a misapprehension to exclude from the estimate of *study*, the time spent in recitation, which is surely brain-work of quite as exhausting character as any done by children. It is true that they *enjoy* telling what they know when they tell it quite at ease and under no fear of the consequences of failure, but even then it involves all the complicated mental processes necessary to making a *public* statement, a matter adults are not inclined to consider in the light of a recreation, especially when subject to the interruption and criticism of a superior. And the child's mental effort is by no means over when he has answered his question. He must attend closely to every other question and answer and correction and explanation, and must try to strike the balance and retain the result for a future recitation. Such should be the character of every well-ordered recitation, and it requires *sustained* mental effort throughout, such as may fairly be considered to exceed in *intensity* the effort requisite to prepare the lesson. But when in addition to the legitimate demands of recitation, the scholars are in a state of anxiety and excitement as to the consequences of failure or success on their rank in class, or on the record which is to go to parents and committee, "worry" is added to work, and the resulting wear and tear of brain and general nervous system is out of all proportion to that involved in quiet acquisition of the same task. One need only recall the image of many a class he has seen in recitation,—with its anxious, working faces, over which exultation and mortification chase each other like light and shade, its quivering hands darted into the air at every question and after half the answers,—to decide whether such performances can reasonably be considered as less in the nature of mental effort than what is usually termed "study."

It must be remembered, also, that time spent in study at home is just so much taken from the opportunity of air and exercise. No child should study immediately upon reaching home; consequently the home study will, for at least half the

year, fall in the evening, when the mind is least vigorous and the light most trying to the eyes,—reasons in themselves sufficient for making it short, when any is required.

REFERENCES.—Reports of Superintendents of Boston and New Bedford, 1872. "Massachusetts Teacher," September, 1873, p. 332.

QUES. VI. Is a single *long* session different in its hygienic influence from shorter sessions?

Answered substantially as follows:—

"Worse," by	89
"Worse, except for upper classes of high schools," by	1
"Better," by	7
"Better in cities," by	1
"Better if divided by a long recess," by	1
"Better for scholars living at a distance," by	1
"Not different," by	3
"Uncertain," by	42

66. "Two sessions decidedly preferable. A four-hour session would be decidedly too long; and yet, in summer, have *twelve* hours for idleness, running the streets or dissipation."

68. "Without more frequent intermissions—yes."

111. "I wish I could adequately express my sense of the importance of the issue which this inquiry presents. Everywhere the tide is setting more and more strongly against two sessions. Upon this matter parents, pupils, and it is to be feared, a large majority of teachers, are in unison. The decision of the point in question is generally affected by the loss of simpler habits of living, by changed hours of eating, and by the growth of large cities and towns. And yet a single five hours session violates every principle of school hygiene. During the last two hours of such a morning, teachers and scholars, jaded by the labor and confinement of the time that has gone before, are incapable of the best work. When the time is at last ended the impulse of all is to escape from the place of imprisonment with the least possible delay. Questions that have come up, and the answers to them, must wait till to-morrow. A growing child needs a meal at mid-day. A teacher's need of such a meal is scarcely less than the child's. The interval between a child's light breakfast and his dinner cannot safely be made much more than five hours. When the single long session is established, this interval can rarely be less than seven hours, and must often extend beyond that time. The luncheon carried, or the pies and tarts devoured at the nearest shop, only aggravate the injury. We ought cheerfully to accept the fact, that for our children, school duties are the appointed and all-important work of each week-day. Time enough can be found for all needed exercise and fun without crowding all study into one-half of that day. In deciding this question, fathers and mothers should weigh nothing else than the welfare of their children; and it may be well added, that the interest of the children, in a matter of such moment, cannot fail to be also that of the whole household. The plan of get-

ting rid of all school before dinner deserves to take rank with 'French in four easy lessons,' and all kindred absurdities. The difficulty felt by a small minority of scholars in getting home during the interval, in the case of schools supplying unusually extended districts, is the one valid objection to what has here been urged; but in the few instances of this class, it would be far better that the school should furnish pupils thus placed, dinners at cost, as the Boston Institute of Technology has lately proposed to do, than to attempt one long session to the positive injury of all concerned."

119. "After an experience of sixteen years' service as one of the board of school committee of this town, during which time the one long session and the two short sessions have been fairly tried, I think that comparing the first hour and a half with the fifth or last of long sessions I invariably find that the pupils are wide-awake, ready to take hold of a new subject and understand it, appetites sharp for new ideas, bodies upright, cheeks with a healthy glow during the first hour. During the last hour, the fifth, there are languid postures, drooping eyes, pallid faces, tired looks, absence of all vivacity, and a painful expression of impatience on the countenance of nearly all. No good study is done after the third hour; the last two hours are spent generally in dreary listlessness or painful attempt to goad the brain on to work."

80. "A long session with ample recess is preferable: recess at the end of every hour, and a half-hour's recess at mid-session."

139. "On the whole I am in favor of the shorter sessions, if the interval is long enough to give ample time for dinner, and allow of moderate exercise, without the necessity of hurrying to and from school."

130. "Inasmuch as the long session is held during the hours when the vitality of the system seems greater, except in the matter of prolonged abstinence, it seems preferable. For young children, it is not to be thought of. A single short session ought to suffice."

This subject should not be dismissed without calling attention to the fact, that the plan of a single long session often leads to serious perversion of appetite and digestion, as is most forcibly set forth in the following quotation from an excellent article on "School Sessions," by Mr. A. C. Perkins, in "Massachusetts Teacher" for September, 1873 :—

"Much of the best material in our high schools comes from the families of laboring men, who take breakfast early and dinner at twelve o'clock. Until the children are admitted to the high school the family can all be together at dinner. After that time there are, every day, vacant seats at the table. The son or daughter, accustomed to take dinner at noon, come home at one or two o'clock, after a fast of six hours or more. The healthy appetite has passed away; the social dinner-table has been set and cleared; the high-school pupil takes his dinner, and, like a dog, eats it alone. Taking it upon a stomach that partakes of the languor and lassitude of the whole system, he fails to enjoy it while eating, or to digest it afterwards. There could not well be found a surer cause of dyspepsia; besides, there is the bad effect of taking a

child from the family dinner-table for three of the most impressible years of his life. A dinner taken under these circumstances, when the brain is weary and the digestion unfit to wait on appetite, must prevent good study in the afternoon."

To this may be added the frequent hurry at breakfast, in winter, resulting from beginning school early in order to finish the one long session by one o'clock. The sleepy—and reasonably sleepy—child dresses hurriedly, bolts a few morsels of food, and hurries off, as ill-prepared for five hours of school and a late dinner as he can well be.

QUES. VII. Do your observation and experience enable you to separate the hygienic influence of *study* from that of emulation, anxiety about rank, etc. (say of work from "worry")? Also from the influence of confinement, bad air, etc.

Of the 111 whose answers are affirmative, there are—

Simply "Yes,"	7
"Mental influences worse,"	4
"Physical influences worse,"	18
"Worry worse than any other influence,"	60
"Quiet, unanxious study never harmful,"	50
"The most studious most hurt,"	1
"Yes, in individual cases,"	1
"Emulation beneficial,"	3
"Unable to distinguish between these influences,"	50
"No harm done in schools,"	2

Of the eighty-seven who state what distinction they can make, only eighteen pronounce the physical influences the most dangerous.

And it is most noteworthy that fifty distinctly affirm that *quiet, unworried study does no harm*, while very many add that it is markedly *beneficial* in its effect on health.

82. "I think that where there is emulation, etc., the nervous system will often throw off, without injury, an amount of work,—mental application,—that would cause injury when emulation is wanting."

85. "I think emulation does not work unfavorably with us."

124. "I consider the hygienic influence of study good as a proper aid to good physical development; but it must be carried only to that degree to *which each individual* is capable without interfering with healthy physical growth. Emulation by ranking is necessary to the proper pursuit of the course of study in our schools. The difference of opinion that exists seems to be due to considering individual cases. I admit its influence upon health

is bad in some cases. No rule or law can otherwise be applied; but that this benefits the majority is, I think, true. The tendency in our public schools is not to overwork. Then some,—yes, many,—need this stimulation to rouse them from careless indifference in regard to study or progress. Tne hygienic influence of this is, at most, but partially bad, while that of confinement in ill-ventilated apartments is universally so."

116. "I must answer *No* to the first question; but I consider bad air the greatest evil in our country school-houses."

20. "I was first led to the inquiry from the effects upon my own children when pupils, as I found their health impaired by position, and one of them by severe pressure from "*Cramming*," so that she lost, at least, two years of her tuition in the high school by disease of the brain, manifested after her graduation. And no books could be allowed her—even light reading. And she nearly forgot all of the last two years' labor, and I had to send her to Boston two years to regain what she had lost. She was never sick, but became anæmic,* and I feared softening of the brain. This led me to inquire if others were like her. I found that two of the class, I think, had died during the vacation, who were taken sick the week after the close of the term, and one lost her place on graduation-day by being taken sick that day, I believe. She barely lived, but did not study and read for months after. The same result has followed with more or less of the class nearly every year since. In my opinion this was the result of crowding, either voluntarily or from emulous motive, or as a necessity to keep place in the class."

79. "If bad air were the cause, both males and females would equally suffer. The cause, by inference, is due to hard study, anxiety, 'worry,' etc., which tell most on girls."

65. "Children should be taught to gain the clearest general idea of their studies, instead of striving to perfect themselves in often worthless details, in order to obtain technical rank. They would thus really learn more, and have a better mental discipline, with less worry."

84. "The public schools of Waltham, of the higher grade, are generally well ventilated and not overcrowded, and it is only in the schools of the higher grade that I have observed deterioration of health which could be ascribed to school attendance. Emulation, class rank, which makes what the readiest scholar can accomplish, the standard for all, I believe to be the chief cause of overwork, and consequent ill-health. Those whom I have taken from school have generally been at the head, or near the head, of their class, or unusually ambitious without special ability."

120. "I do not think the influence of emulation, etc., as injurious, in the majority of cases, as severe study; I think confinement at the desk affects small scholars injuriously to some extent, and bad air would affect all, but I think at this day they suffer but little for ventilation."

125. "In the high school only does the spirit of emulation rage, and that *does seem* to add *strongly* to the influence of study in undermining the health of the competitors, some of whom occasionally break down in the race for the Carney medals. The emulation there is very largely in the direction of good deportment; I believe mainly so."

* Bloodless.

115. "I think that study very rarely injures the health, but that 'worry, confinement and bad air often do.'"

Waltham.—"Out of one class,—seventeen in our high school,—I had to remove nine in the graduating year."

New Bedford.—"Not a class passes through our high school, of which some of the girls are not compelled to discontinue a part or all of their studies for a time; and not infrequently they cease altogether their connection with the school, too feeble to venture a renewal of their studies."

The effect of all varieties of artificial stimulus to study—as we may justly term every motive except desire for knowledge and for approbation—falls most heavily on two classes in school, viz.: those who least need it, and those who can least bear it; the studious or ambitious, and the anxious and sensitive natures. These are spurred to an unnatural effort in order to drag along the mass of the school, the heavier and the healthier natures, at a rate which they would not otherwise attempt, in which process the strain falls of course on the leaders, or on those who seek in vain to lead. The standard of attainment is in very many cases an unnatural one, indicating, not mainly how well the subject has been mastered, but in what *style* the lessons have been recited, and how much better than the average style. And it is just in relation to this standard that the children are anxious and worried. It is not enough for them to have comprehended the lesson and to be able to state its main points fairly. They cannot be easy in mind unless they are sure of every detail, and of reciting in the canonical method,—for even if they are not censured for falling short in these respects, they will miss the highest mark, the testimony of having complied with every requirement. The consequence is, that they spend a most unnecessary time over their lessons, and are in a state of apprehensive anxiety while studying and reciting. They are worried and nervous. Fortunate is the "average child" who can "shed" this "worry," as a duck sheds rain, who leaves all thought of school behind, when he leaves the school-house and is absorbed in his play. If girls could do this equally with boys, school would less often harm them.

One of the worst things which can be said of our present school system is that this evil of "worry" falls most heavily on those scholars who are longest and most completely under

that system. It is in the graduating classes of the grammar schools and in the small proportion who pass through the high schools that the evil is most conspicuous, and as has been said, the number of pupils over fifteen years old is increasing in nearly double the proportion of the general increase of attendance.

And public exhibitions, examinations and graduating exercises, *as usually conducted*, are admirably calculated to bring the evil to a climax. Acquiring with every year more of publicity, more of excitement and display, more of complication and expense, they prove—far oftener than the public suspects—the last ounce that breaks the back of physical and mental endurance in the girls of these graduating classes, leaving them exhausted and excited for months, and sometimes for years.

Now, this "worry" is as unnecessary as it is mischievous. The excitements to it are factitious, and we can remove them *if we choose*. They do not promote *genuine study*, though they do stimulate mental effort of a sort which by no means leads to the soundest and sweetest development of mind and character.

A certain amount of emulation naturally arises between any persons associated in a common pursuit, and is in its ordinary degree healthful and helpful, and may be expected and allowed in school. But it cannot be made prominent and used as a *motive* without great danger. In like manner the love of approbation is natural and lively in children, and without it our schools could scarcely be carried on; but let us even bear in mind how easily it passes into *vanity*, and how certain the transition becomes when we use it freely as a motive. In the train of vanity and eager competition, we are sure to have strife, envy, feverish hopes, bitter disappointment, and constant *suspense*, all of which wear the brain and general nervous system most cruelly. How can we allow such evils to come upon the children whose education the State assumes?

Doubtless these stimuli of emulation and public distinction are very convenient and powerful motives, but they are neither as sure, as enduring nor as *safe* as love of knowledge, interest in the subjects studied and an honorable sense of

duty. Of course under either system there must be method and discipline. Children must do many things with but a very imperfect understanding of the reasons why they are required. *Authority* must have its place quite as distinctly as *attraction*, but that is a false method of education which continues to employ motives which are dangerous, because they are speedy and convenient. A generation ago frequent corporal punishment was thought essential in every school. Now it is discarded as brutal and brutalizing, and is retained only as the last resort. It is to be hoped that we shall not wait for another generation to banish the use of unworthy and mischievous *mental* motives from the schools of Massachusetts.

QUES. VIII. Is the occupation of school-going worse, hygienically, than other occupations in which children would engage if not in school?

Answered as follows :—

"Yes" (unqualified), by	11
"Yes, in farming towns," by	5
"Worse than work out of doors, better than work in shops," by	5
"Worse than house-work, or than out-of-door work," by .	1
"No" (without material qualification), by	82
"Not in factory towns," by	15
"Not necessarily," by	8
"Not if judiciously conducted," by	7
"Uncertain," by	11
"No answer," by	4

Analyzing the above as regards the comparison between school-going and manufacturing of any sort, we get in favor of school 108 out of 142, and without doubt the proportion would have been greater still had the question been put as between the two ; but we should then have lost any expression of opinion as between school and house-work or out-of-door work, in regard to which eleven make the distinction against school.

64. "Yes, if the number of hours is considered."

133. "As most schools are conducted, I think it is. I think it need not be so."

105. "Commonly, perhaps better than those in which girls in our cities and villages (with the present *insane* notions about work, dress, society, etc.) would engage; but not as good as those in which most boys would engage."

130. "Only as regards mental anxiety. Dealing with matter is easier than mind. Six hours' work at any occupation, besides, does not seem as fatiguing as 'going to school.'"

139. "That depends on the social status of the child. In the lower ranks —the lowest, I might say—it is *not*. Among the better classes, it may be an open question."

80. "No, not so bad as monotonous, unintellectual labor, in which *thought* (or rather the thinking *power*) has no part, and from which it receives no food. On such labor, thousands of children in New England are engaged from ten to twelve hours daily, without the slightest regard to their mental or physical health. Study and work mutually co-adjutant, will give 'a sound mind in a sound body,' both of which our methods tend to impair."

107. "In the whole of my practice I have never attended a child whom I have thought to have been injured by overwork at school. It appears to me impossible to injure children by obliging them to attend school but four hours and a half a day, quite a considerable portion of that time being passed in recitation. Anxious parents are very apt to conclude that a child has been made sick by overwork at school, when it was satisfactorily proved by our fathers that children flourished and grew strong under the two-session system. I am satisfied that many children are seriously injured by exposure and excessive exercise in vacation, who would have escaped sickness if they had been obliged to pass four hours a day in the school-room right through vacation. If a child breaks down in the middle of vacation, parents are apt to attribute it to overwork during term-time, when a physician who has not this bias of over-brainwork on his mind can easily see that the child has run himself sick. Children are much more happy for the discipline of the school-room, enjoy their sports much more, for the spirit of freedom which they feel, when rushing out from school, they are brought together with their mates to unite in sports and games of which they get tired when licensed in vacation to run riot by themselves, when they have too many play-hours. The atmosphere of the school-room is better than that of many of their homes, and most of their tasks are in themselves amusement."

There will probably be very general assent given to the opinion of the great majority of these "correspondents": that ordinary school-going is a far more wholesome occupation for children than any kind of manufacturing. In the first place, because the average number of hours per day at school is about one-half that required in factories or workshops. In the second place, because in many of the latter the hygienic conditions are worse than in school, even for equal periods of time; and in the third place, because a certain amount of unstimulated study is distinctly beneficial to bodily health, the brain demanding, like the other organs, suitable employment as a condition of normal development, and rejoicing, as

much as do the muscles or the lungs, in the *play* of its powers. But it must be remembered that there are other occupations than factory-work open to children. House-work for girls, farm-work and various healthy trades for boys; gardening for both sexes; and in the comparison with these, school-going cannot appear so favorably. Whether we consider the quality of air, the degree of bodily constraint, or the mental activity, these occupations have immensely the advantage over work in factory or sewing-rooms; while on the first two counts they must be preferred to school-going, and on the last they are, in certain respects, superior to mere book-study,—every way superior to it when it is ill-directed, mechanically performed or artificially stimulated.

They occupy and train the mind more than factory-work can do, not narrowing it down to the petty round required by the close subdivision of labor inseparable from tending most machines, but calling for constant use of the perceptive powers,—of comparison, of contrivance, of judgment,—and uniting with all these such constant use of the bodily powers as serves at once to fix the mental impression, and to associate mental action with practical *affairs*, an association always delightful to children, and to which our school-training pays far too little heed. And we must not forget that to this class of occupations children turn more naturally than to work as "operatives." In such occupations, and in play, their time would be spent, if they were not in school. In the opinion of the writer, then, Question VIII. may properly be answered,—"School-going (as found in ordinary schools) is a far more wholesome occupation than factory-work, or than sewing; it is less wholesome than light 'house-work,' farm-work, gardening, or work at several of the leading trades. But it might be brought more nearly to the hygienic level of these last, and in the words of Mr. J. D. Philbrick, we ought to aim, not merely *to avoid injuring* the health of pupils while carrying on their instruction in our schools, but *to increase* their physical health, strength and beauty."

QUES. IX. Have you any opinion based on observation of the so-called "half-time system"?

Answered,—"No," by	. . . .	135
	"Yes, favorable," by	6
	"Yes, adverse for common schools," by . .	2
	"Yes, favorable for factory children," by .	1

The object of this question was to obtain information in regard to the practicability of uniting with what we now conventionally term education, some industrial education, in a way to secure a sound mind in a sound body. The answers imply so general an ignorance of the method by which the English appear to be accomplishing this most desirable result for their young operatives, and of the three or four schools on a similar plan in our country, that some explanation seems necessary.

The name of "half-time" is given in England to a system of schooling provided by law for children employed in factories and workshops. By means of it these children have secured to them for daily instruction one-half the number of hours spent in the government (*i. e.*, the public) schools by children not at manual work. It has been in operation for about 30 years, and full reports of its working, made by competent and faithful official inspectors, are to be found in parliamentary documents. It was devised for the protection of the state, and of these factory children, against the danger of their growing up in ignorance of the elements of book-education, and is an immense boon to them. But a most unexpected result of it has been to prove that these "half-time" scholars learn quite as much as the children who are in the same schools twice as many hours a day. And as it would be admitted that true hygienic conditions would be much better secured by a system which should require but half the time now given to study, and yet accomplish as much as at present, while in the remaining half of the school-day it trained the children in manual operations, it seems within the scope of the present paper to offer for public consideration certain evidence—not otherwise accessible—which the writer, in common with others whose opinion is entitled to greater weight, considers of public importance. It will appear on a moment's thought that in school-workshops children who were employed for two or three hours in the afternoon would be free from the *mental* dangers to which they are now more or less

exposed in school, while ventilation could be much more easily secured (as it is now while the physical exercises are going on in school), and that they would not suffer from enforced quiet, long sitting, etc., unless they were at needle-work; and a proposal to substitute such a system for our present one, would meet with general favor, if it were considered as among things *practicable.* With the poor it would be very popular; it would draw in a large proportion of those who are now in no school, though within the school age, of whom there are not less than 15,000 in Massachusetts, and it would certainly lead to our children remaining longer at school than is now the case with the majority of them. All of which things would conduce very much to the *physical well-being* of those who are, or ought to be, at school. It is, of course, no essential part of the system under discussion that the school-hours should be *halved* between industrial and book education. The fraction allotted to the former might be two-fifths, or one-third, as experience should decide.

It is of interest to observe that the report furnished within a few weeks of the results of introducing systematic instruction in sewing and cutting garments into one of the girls' schools (Winthrop) in Boston, for two school hours each week, shows that the *ordinary lessons were quite as well learned* as before these two hours were taken from study.

In the discussion of a subject of so great importance, and yet so seldom considered in the United States, as this of half-time schools, it becomes not only of interest, but of consequence, to know the character and qualifications of the witness whose testimony is offered in evidence; and for this reason the names and antecedents (as bearing on our present subject) of the more important "correspondents" quoted, have been given.

69. "I have seen such a school in operation, and originally confined to factory children, as, I presume, it still is. I should prefer it, because it gives variety in the use of time; combines a reasonable proportion of physical and mental employment daily; starts ideas in a class of minds little disposed to entertain them when benumbed by a long day's work; and better fulfils the idea of social and special instruction than schools more bound up in a large and connected course of study."

102. "Kindergartens and industrial schools and half-time systems give a change of occupation; but these should never let a child do all he can do,—allowance should be made for the fatigue of each set of powers."

134. "I have had but little experience in the so-called half-time system, and I am not, therefore, in a position to offer any decided opinion. I am, however, firmly convinced that seven, in place of five, should be the minimum legal school age, and that up to nine years of age pupils ought not to spend more than three, or, at most, four hours per day in school."

118. "The half-time system is good for children in mills, etc., who cannot go to school the whole time, on the principal that half a loaf is better than no bread. But the ground taken by some educators that the half-time system gives time enough, is contradicted by all observation, and is an error of grave proportions."

122. "It worked well during a limited trial given it in this city. But I believe it is not allowed by the corporation now."

20. "The evidence of improvement in half-time over whole time is in the general vigor of the pupil, promptness in recitation, and diminished mortality during the *summer vacation* from *diseases* of the *brain*."

The following evidence is from Philip P. Carpenter, Ph. D., of Montreal, a scientific man, occupied now and for many previous years in teaching, familiar with sanitary matters, and a close and independent observer. The fact that he alone, of all the correspondents, has had extended, practical experience of half-time schools, seems to warrant quoting him here at length and on points of general educational interest rather than of hygiene. The thing of which the public needs to be convinced is not that industrial education is *desirable*, but that it is practicable to give it together with as valuable book-education as we are now giving. And on this question Dr. Carpenter's testimony is most direct and valuable.

127. "I lived twenty-three years in the heart of the Lancashire factory population, at different places, and all the time paid the closest attention to education, and especially to the half-time system, which approved itself to me at first as being *natural*. Latterly, this system has been so developed in Britain, that special inspectors of half-time schools are appointed, and their yearly reports, easily accessible, are, I think, nearly unanimous in favor. It may be considered as *proved* by *long experience* that (other things being *equal*) an average child of fourteen, from a half-time school, knows as much 'in education' as one from a whole-time school. Many inspectors say *more*. Besides the education, so called, the half-timer has learned the *work*-education, in some respects even *more* valuable to the individual and to society than the book-work. A Yorkshire half-time scholar is now the respected chaplain of Sing Sing Prison. Any number of similar cases can be found. Before the inspectors had collected their experience I had formed my own, from two sources.

"(1.) In 1848, all the mills in the town being shut, my sister and I opened industrial schools for the young unemployed, in which the scholars (from 12 to 20) were in the workshops three hours and in the school three hours daily. When the mills re-opened, I was amazed to find how much the classes had

learned from this short schooling, although several knew absolutely nothing on beginning.

"(2.) I kept on some of those scholars permanently, as printers, receiving from them ten hours work daily, and giving them one hour's schooling after dinner. I was able in this short time to give them not only common, but advanced, instruction; and some of them now hold distinguished positions both in England and the United States. It was my cherished desire in removing to the New World, to give to the richer classes the advantage of half-time schools, which the English poor possessed; but thus far I have not been able to start such a school, in consequence of the almost total ignorance which here prevails on the subject. I am deliberately of opinion (after having been an active teacher of boys, both rich and poor, for nearly forty years), that if the half-time system prevailed, the following advantages might be expected to follow:

"1. The industrial part *uses* pleasantly, healthfully and profitably, the *animal energy* of the growing boy. It *lessens* the temptations to sexual excitement, to which well-fed, sedentary, nerve-excited boys are unnaturally liable. It *forms habits* of obedience, quickness, care, *industry* and *utility*, in a manner much more agreeable to boy-nature than the discipline and punishments of school; those habits being of the utmost importance in future life, in all occupations. It *breaks down* the old slaveholders' doctrine, that bodily labor is degrading; that common people must work with their hands, but that gentlemen's sons need not. It has a tendency to produce a race of men who know how to turn their hands to any kind of useful work, and to guide said hands by good heads. It gives the same recreation as *play* does, with useful results and Christian economy.

"2. *The school part* presents boys with heads not overworked, and bodies naturally developed. The study is pleasing diversion from the workshop. The teacher, instead of losing a large part of his time in more or less unsatisfactory attempts to get his class into working order, finds boys already brought to order by the discipline of the shop. Each department helps the other, and is yet a relaxation to the other. Probably a half-timer will learn as much in a fifteen minute's lesson as a common scholar would in thirty minutes.

"There is a general feeling now that emulation and book-work have been over-stimulated, and a movement for shorter hours of school. But with what results? The boys *play* more; probably are more *healthy;* but are not better scholars, because the play-ground does *not* teach useful work, orderly obedience, etc., as the workshop does. It has been found, in many of the largest and best conducted schools, that Mondays are hard days to the teacher, because of the two days without discipline [Saturday being generally a holiday]. Also, now, there is a complete break between school and work, to the detriment of each. A boy gets tired of school; goes to work (long hours) perhaps at fourteen; does no book-work; and at eighteen has lost most of school *knowledge*, and school desire for learning. Whereas, in the half-time system, both work and learning would begin early, go on together, and might be continued indefinitely through college or technology training.

"The feeling of boys, that they are 'above work,' is a diabolical principle, which culminated in the Southern slaveholding, but poisons the whole of society in proportion as it exists. If I must have either *exclusively*, I would say the education of the *shop* makes a better *man* and *citizen* than the education of the school; but of course neither *ought* to be had exclusively.

"When I first travelled in New England, I got among the English emigrant factory people. They all lamented the non-enforcement of the English factory laws, especially for ten hours, and half-time schools. I found, even in Providence, that scores, perhaps hundreds, of children were growing up *without any education*, in spite of free schools, etc. The greedy parents were allowed to send them at almost any age; they worked as long as the men; breakfasted before six, worked six whole hours; only thirty minutes for dinner, and then six hours more, ate supper, and were unfit for anything but bed. This, in the boasted New England; while in Old England, not only no child under fourteen can *work more* than five hours in any shop, or other associated labor, but *must* be at school for three hours. Really, the Yankees, who beat the English in so many things, ought not to be so far behind them in the employment of women and children, and in the teaching of the poor. But, as I have said, the rich really need the half-time discipline, though as yet they do not see it. Whoever can get the half-time system thoroughly worked in America, at least *as well* as in England (it should be *better*), will be one of the very greatest of public benefactors. Would that even my poor opinion could be carefully studied."

The following is from Geo. H. Dunbar, M. D., mayor of New Bedford, and chairman of school committee of that city:—

"I believe six hours daily attendance at school is not too much either for mind or body, provided the studies be judiciously regulated.

"The fact is, the number of the school studies and exercises which are considered necessary at the present day, is too great to be properly accomplished in the prescribed number of school hours. They are too many, not because the strength of the scholars is not sufficient for them, but because they are crowded into too narrow a space.

"The basis of the reasoning by which the advocates of half-time schools sustain their measure is truly astonishing. It would be very well in the mouths of the thoughtless and inexperienced in educational matters, but when we hear it from the lips of experienced educators, we hardly know what to think of such a weak, unsupported assumption.

"The grand effort is to get half of the school hours to be devoted to handicraft of some kind. But to justify the transference of so much time from study to work, it is necessary to assume that enough study for all practical purposes can be accomplished in half the time now devoted to it.

"What is the fact? Simply that our scholars leave the grammar schools at the age of fourteen, miserably cultured in anything. They are not grounded thoroughly in the elements of arithmetic: they have the vaguest conception of the facts of geography and history, which they have been over; they are poor spellers, and as for the possession of a good vocabulary and the power of using it in written composition, they are sadly deficient. In addition, they are not accurate in their practical work, nor have they obtained many general resources, fitting them to come in contact with the practical affairs of life.

"It may be said that there is now a misapplication on the part of the teachers.* They do not discriminate rightly between what is essential and

* Or rather committees? (F. W.)

what is non-essential in school-work. The scholars would be better taught in less time with a different kind of teaching.

"But, however true this may be, it only amounts to a partial modification of the general principle. Do the best one can, and the time given to study in grammar schools, with an average class indiscriminately gathered from different classes of citizens, will accomplish very little.

"How is it abroad? What lessons do we get from countries which have made the matter a profound study? Prussia will not allow anything but the barest elements in the ordinary schools, up to the age of fourteen, on the express ground that there is no time for anything more. The children hammer away at the elements more hours a week than our American children give to study, and yet can barely master the elements. And yet it is assumed that half a day, to the age of fourteen, is enough for a good ordinary education. Those who thus reason have the defective traditional New England notion of what an elementary education is, as exemplifying the true ideal of the possibilities and necessities of common-school culture, and because boys and girls can be taught in the half-days of a few years to read without much stumbling over words, to write only semi-obscurely, and to spell a goodly number of words of which not one in ten is understood, and to cipher correctly under the fundamental rules, they are thought to have acquired quite a respectable elementary training.

"And yet what does so much amount to, more than the barest familiarity with the instruments of knowledge, without any actual acquirements of knowledge itself?

"In the case of mill children half-time schools are very well to advocate, because they are better than nothing. But that they are sufficient is contradicted by the history of instruction, its results in all ages and all lands."

In response to the above, Dr. Carpenter writes again as follows :—

"I am very much obliged to you for the sight of Mr. D.'s letter. I never saw before such a strong testimony to the inefficacy of present arrangements; but it entirely bears out my own (not slight) observation. I came to the United States, expecting to find their schools incomparably better than the common government schools I left in England. On the contrary, *supposing the present states of things to go on as they are on each side the Atlantic*, it is an open question whether the present rising generation of British people will not turn out more usefully educated men, per thousand, than the Americans.

"Mr. D. quotes the same inefficiency as the acknowledged result of the Prussian system; although that is superior to the American (1) in being compulsory on the children; (2) in the teachers being compelled to acquire a higher standard. As to the requirements and instruments of education, it may be fairly assumed that the three nations have equal advantages. At any rate, they can easily copy each other's improvements.

"The comparison, then, by Mr. Dunbar's own showing, is this:—The Americans provide excellent voluntary schools for all, and spend whatever is requisite in making them effective; but they do not compel, and they make next to no provision for the education of workers. The Prussians have equally good schools with the Americans; they do compel, but they do *not* provide education for workers, said education being necessarily acquired *before* an apprenticeship can be signed.

"The English think their schools are as good as the Prussian and American; they do compel: they make compulsory provision for the education of workers.

"Now for results. Mr. D. professes failure for the Americans and Prussians; the English inspectors profess unexpected success for their system. Other things being equal, is there not an *a priori* case in favor of the English system? The English are a proverbially conservative and practical people. They will not adopt a change, unless they are forced to believe (*a*) that a practical benefit will result, and (*b*) that that benefit will outweigh the evils of the changing. Now, the English, of late years, have made the following changes:—1. Compulsory education for all; 2. Apprenticed teachers; 3. Searching, permanent government inspectors, both of teachers and scholars; 4. Payment by results; and 5. Half-time schools for all young workers. The first four do not affect the present question; their absence in America may have much to do with the imperfect results presented by Mr. Dunbar.

"The fifth was forced upon the manufacturers as a palliation of the spreading ignorance at that time only counteracted by the Sunday night schools. It has turned out an unexpected success. The government inspectors, accustomed to examine the ordinary full-time schools, declare, and keep renewing their declaration, that these schools generally equal, sometimes surpass, those of ordinary children of the same age. Here are FACTS, testified to, year after year, by educators of the highest probity and experience, founded on the examination of myriads of children.

"Among all the problems that ought to be thoroughly studied by American educators, I know of none more important than this. It appears to me, after long study of the peculiarities of British and American children, even more certain to be beneficial for the latter than it has been proved to be for the former."

The following is from Gen. H. K. Oliver, who has given a great amount of investigation to this subject, and is probably better informed in regard to it than any other person in Massachusetts, as will appear from perusal of his report when chief of the Bureau of Labor Statistics, which are referred to by volume and page among the references at the end of this division of the paper.

"My experience with children and young persons has been of a nature somewhat exceptional. I was a professional teacher for twenty-three years, from 1819 to 1844, in Salem, first in the Latin school for eight years, fitting lads for college; secondly, as master of our English high school, fitting them for a business and practical life; thirdly, in my own private academy, doing both the above for six years, and then for eight years instructing girls, between twelve and twenty, in all the studies pursued in the more advanced establishments. Four years later, I took charge of a large cotton mill (the Atlantic, in Lawrence), for ten years, employing an average of a thousand persons, men, women and children. During six years, from 1866 to 1872, in the employ of the State, two years in examining into the condition of factory children, and four years as chief of the Bureau of Labor, the subject of education held, as before, a predominating place in my thoughts and studies,

and inquiries. During many years of my life I have been on school committees, have acted as school superintendent, and as agent of the State Board of Education. Indeed, I can recall no time of my life since leaving college, in 1818 (I am now 73 years old), when this subject has not been with me matter of earnest reflection and solicitation."

"My experience and observation are based upon a little that I have seen of half-time schools, in Massachusetts, in which State alone any exist that I know of, this side of the Atlantic. My knowledge of them, otherwise, is derived from conversation with Englishmen, and a pretty extensive reading. At Salem and at Springfield the experiment has been tried with marked success. The Factory School, at Fall River, is a school in which the children spend three consecutive months, and are then nine months in the factories; and even the first-named schools are attended by the factory children but six months, each group, so that they really get but *one-half of six months' schooling,* three months being all that our state laws require for such children each year between their tenth and fifteenth years. For its perfect working, the children should be half-timers all the year round."

"The half-time system was originally intended, indeed, and may be yet continued, mainly for factory children. I believe it will prove advantageous for all children, and for youth also. But eminently due is it to this sinfully neglected class. Its omission will be sure to be ultimately avenged upon the States that permit it."

"As applied to the half-time system, the simile that 'half a loaf is better than no bread,' is not applicable. It by no means follows that if a certain amount is learned in *three* hours, twice as much will be learned in *six* hours. All experience is against it, to say nothing of its being invalidated by the very nature of the subject itself.

"The last hour of school-time of the double session is very unproductive; disproportionately so. Teacher and pupil are alike drooping and inanimate, the wasting away of brain energy in each not being adequately repaired. Rest, or change of work from brain-work to muscle, is then a positive necessity.

"A point well taken in this connection is the uniform testimony that the *concentration* of *attention,* proved in England to have been the normal habit during the fewer hours, is the great auxiliary in securing knowledge, the re-action in changing from bodily to mental labor helping this; and the *habit* of *close attention* when at manual work, being still operative when the change is being made.

"For the purpose of mere sole *mental* training, with the only intent of making a man a *scholar,* and nothing else, I do not know 'that the half-time system gives *time enough.'*

"But it is not to the merely scholarly that we are looking. Seven-eighths of our boys and girls at school, nay, a greater proportion, are to be enrolled among the wealth-producing classes, which this vast country demands and must have for its development, and it is the question now paramount how best to train our youth for that mission."

The following communication bears on the discussion, inasmuch as it shows that under a better *system* more can be accomplished, and *in less time,* than under our present school system:—

"I know nothing personally of the 'half-time' system, technically so called, but I have had with my own children practical experience of what may be accomplished in from two to four hours' daily sessions, under judicious management of studies.

"My oldest daughter, now just over 13, has attended the same private school since she was five years old. She began with but one hour, a day, and this was gradually increased to three, and then four, and for two years past she has had an hour's study out of school; before that, none. The school was small, varying from six to twenty pupils, and under the charge of a highly educated lady. My daughter, at 13, stands, with regard to her school acquirements, as follows: In arithmetic, the great standard in our public schools, she has done but little, having only a perfectly intelligent and practical knowledge of the subject, through fractions, vulgar and decimal. In geography she has an excellent general knowledge, physical and political, though there are many topographical details that she has never learned, and therefore never forgotten. English grammar she has studied but little, and could probably not 'parse' to the satisfaction of any examining committee, but she understands the construction of sentences, and can 'write and speak the English language' with as great correctness as is desirable in a child of her age. In spelling she would undoubtedly fail in a 'match' from the spelling-book, but she rarely makes a mistake in words in ordinary use, and can write pages of composition with scarcely an error. In history she is well grounded in the elements of Greek and Roman, French and English History, and knows something of that of the United States (more difficult than either). She has a good general knowledge of English literature, as far as a girl of her age is competent to understand it, having taken it at school in connection with English History. In science she has made no great attainment, but she has learned the practical parts of physiology, and has studied enough of botany and natural history to form an intelligent basis for more. She draws well enough for her age, having practised from objects, casts and busts, as well as from the flat. She has a good knowledge of the Latin grammar, and has read in Latin through several books of Ovid's Metamorphoses. She translates readily from any ordinary French book, knows the grammar very well through the third part of Otto's, pronounces well, and speaks and understands the language as well as can be expected from one who has never heard it talked. This is not any remarkable standard for a girl of 13 to reach, but such as it is, it has been reached with the very few hours' daily work above mentioned, and wholly without artificial stimulus of any kind, and absolutely without worry or anxiety. I may add that she has learned at school to read music, so as to sing readily at sight.

"My other children, eight and ten years old, are following the same course of few hours' school, and no excitement but such as an interest in their studies may give; and with the result, so far, that they are both decidedly in advance of children of their ages in the public schools, who go to school five hours a day. They study a greater variety of subjects, having French and History, besides the ordinary school-studies; they have more writing exercises and more natural science. I know that the difference is partly due to the smaller size of the school, but more, I believe, to a judicious selection of the essential parts of the subjects taught, and the omission of many useless and burdensome details, and of the sort of drill 'necessary to prepare for public examinations.'"

References.—Parliamentary Documents for last fourteen years; British Social Science Papers, 1860 and 1861 (papers by Edwin Chadwick); "Massachusetts Teacher," vol. xix., 1866; Reports of Mass. Bureau of Labor Statistics, 1871, pp. 493–498; 1872, pp. 448–467; 1873, pp. 370–396.

Ques. X. How can our schools be modified to improve their hygienic influences?

(*a.*) As to tasks and discipline?

Answered substantially as follows:—

By "lightening discipline,"	25
"increasing discipline,"	1
"more perfect discipline,"	1
"military discipline,"	1
"lightening tasks,"	38
"increasing tasks,"	1
"abolishing tasks at home,"	5
"pursuing fewer studies,"	14
"pursuing fewer studies at a time,"	5
"a longer course,"	3
"lessening routine,"	32
"teaching children how to prepare lessons,"	9
"more training of the perceptive powers,"	11
"reform in study of arithmetic,"	1
"reform in study of geography,"	1
"abolishing home study of arithmetic and spelling,"	1
"more variety of exercises,"	13
"more cheerfulness,"	24
"more supervision in play-grounds,"	1
"better knowledge of the laws of mind in teachers,"	5
"more discrimination on part of teachers,"	30
"teaching hygiene to teachers,"	6
"teaching hygiene to children,"	2
"adapting tasks and discipline to the *average* child,"	7
"simplifying of text-books,"	2
"abolishing marking for rank,"	16
"abolishing public exhibitions and examinations,"	3
"abolishing keeping in at recess or after school,"	4
"employing more mature teachers,"	1
"paying teachers better,"	1
"returning to district system,"	2
"establishing half-time schools,"	4
"No improvement needed,"	3

Analyzing the above suggestions, we find the reforms which are most frequently called for to be as follows:—

1. Lightening tasks,	38
2. More discrimination on the part of teachers,	37
3. Less routine in methods of teaching and reciting,	32

4. Lightening discipline,	25
5. More cheerfulness,	24
6. Abolishing "marking" for rank,	16
7. Pursuing fewer studies,	14
8. More variety of exercises,	13

To such material as these replies, the "numerical method" of reasoning is but very partially applicable, and we do not propose to use it farther than to indicate where the predominance lies *numerically* among our witnesses, with a view to showing how generally certain hygienic evils are distinctly recognized by them as existing in our schools. But one may easily be led to draw false inferences from these figures, unless he carefully compares and considers *all* which are submitted. For instance, under Question X. *(a.)*, it appears that but five recommend that no lessons be assigned for study at home; whereas, under Question V., more than eighty have declared themselves adverse to such study, and seventy-five of them did not care to repeat themselves. While, on the other hand, under Question X. *(b.)*, the seventy-seven who call for improvement in ventilation had had no distinct opportunity earlier in the circular to state their views on this point.

One who carefully compares the tabular statements under Question X. (*a*), with the quotations from individual correspondents and with the numerical statements, as well as the quotations under Questions III., V. and VII., must perceive that it is far more the effects of anxiety and excitement as to "standing" in the class, in the eyes of teachers, of committees, of audiences on public occasions, etc., which are lamented and dreaded by the "correspondents," than the effects of genuine *study* without *artificial* stimulus. If in addition to these evils we could rid the schools of unnecessary anxiety as to promotion from class to class and from school to school, we should have eliminated the greater part of the "worry," which now works far more harm than all the other mental causes together. There is certainly no occasion to enlarge here on the desirableness of such a deliverance. The only difference of opinion would seem to be as to the practicability of the changes implied, without removing the incentives to study to such a degree as to very much diminish the value of school

instruction and training, and leaving the teachers without efficient means of obtaining discipline, attention and application in their schools.

To set forth with any fulness the reasons of those who are persuaded that the changes can be made, and the schools at the same time be made more, rather than less, educationally efficient, would require a bulky treatise, while the purposes and the limits of this paper allow only of pointing out evils and suggesting remedies, leaving the discussion, as to the correctness of the educational philosophy involved, to be carried on elsewhere.

The following suggestions are selected from the "correspondents":—

139. "By limiting the school tasks to the capacity of the average pupil,—by requiring no more than the average pupil can do without over-pressure during school-hours, or the necessity of any long-continued application out of school. I do not object to a moderate amount of out-of-school study, for boys. In case of two sessions, I would have the lighter tasks come in the afternoon.

"When tasks are appointed, they should be better considered than they sometimes are. Their connection with future progress and profit should be explained. Much that text-books contain should be omitted, or left for future criticism. Tasks should be always so short as to be mastered perfectly. They should not be given as a penalty for deportment or neglect. Discipline so varies with the individual teacher that one can hardly give a general answer. Believe that *forethought* is the best substitute for discipline."

118. "By a judicious alternation of the studies, so as to appeal to different classes of faculties, and in different degrees. By a proper supply of objects for objective teaching, so as to relieve the scholars from the wearisome brain-work of forming conceptions of things from verbal descriptions, when the *things* might just as well be shown themselves."

80. "My answer to the first part of your query (*a*) is, *less* tasking and *more teaching*, and more wagon-loads driven through each of the five gate-ways of knowledge by masters wiser than most we have. If any one profession needs to be brought up to a higher standard and to a greater power *to lift*, it is the profession of teaching. We need more *teachers* and fewer school *masters*."

35. "Children well trained at home need very little punishment in school. A successful teacher once said to me, 'When the scholars get restive and uneasy I introduce singing with happy effect.'"

111. "The far too exquisite order to be seen in some school-rooms, filled with very young scholars, is, in my judgment, one of the worst facts about those schools, and I know it to have been obtained by methods as objectionable as those employed in teaching trained dogs and monkeys their tricks."

114. "The scholars are not taught as they should be HOW *to* STUDY. If they had certain tasks sufficient to occupy, intently, every moment of an allotted time, and understood that the lesson must be learned in that time or failure result, I think the pupils, from the intermediate years upward, could be made to acquire vastly more knowledge, and, what is of more value than that, even, the best way of acquiring knowledge. This *intense* study would be the *discipline* which I would use; and the consequent gain in hours for recreation, together with cheerful, well-ventilated rooms during school hours, and systematic exercises in the open air or in properly constructed halls during stormy weather, would be the best aid to successful physical development."

80. "By adopting the principle of the technical schools joined to the use of our common schools. (For details, see Scott Russell's work on Technical Schools.) I believe it would radically improve our system, make school attractive to those to whom it is now repulsive, and draw in the twenty to thirty thousand children between five and thirteen years old, now not accounted for in any school in Massachusetts."

105. "These seem to me to be generally well enough hygienically; not generally excessive in amount or severity. It would, doubtless, be better for the health, as well as for the intellectual progress, if the pupils thought more and committed to memory less."

The frequent reference to and illustration from practical life, which is needed to make studies connect themselves with the world which the child knows, is peculiarly demanded in the case of physiology and hygiene, both in teacher and scholar.

103. "There is a great deal of nonsense in our schools about hygiene, practically. The child gets the *theory* into his head, and is thus drawn into the delusion that having fluently and parrot-like recited the lesson on hygiene he is all right on that subject for the rest of his life. You may just as well try to make the child virtuous and pious by teaching *seriatim* a whole 'body of divinity.' It is the *guiding the child into correct hygienic practice* that we want, and then let him study theories and principles of hygiene when he has a sufficient substratum of knowledge to understand and appreciate their value. Then, and then only, will 'book-hygiene' be of any value."

The suggestion of "lightening tasks" would perhaps be best met by *abolishing the ordinary incentives* to EMULATION and by "*adapting tasks to the capacity of the average child*," studying during school hours only. For high schools and the highest class in the grammar schools, a single hour of study at home would be safe. It will not be the case that a lesson assigned has been "adapted to the capacity of the ordinary scholar," unless some instruction has been given as to the best way of preparing that particular lesson or the

class of lessons to which it belongs. For want of such instruction there is a deal of blind groping over school-work, stupid and stupifying; to take an illustration from manual labor, doing work by a "dead lift," rather than by strength used to the best advantage. Children are not half taught how to use their text-books to advantage, much less how to use, except for amusement, other books. Especially is this want of instruction how to prepare lessons seen in the case of "reviewing" text-books, the ambitious child being left to wade through the whole mass of a long review lesson for fear of "missing" on some detail. It would often be better for the mental health to "review" in recitation only, without requiring any previous study, than not to indicate to the class what are the important points to be retained in the mind. How often in "reviewing" arithmetic is a child allowed to "cipher" over long columns of problems, without its being considered how much time is required for the mere writing of figures.

"More discrimination on the part of teachers" is undoubtedly called for as to what parts of the prescribed text-books shall be used; as to the order in which certain studies shall follow each other through the day; as to methods of teaching and hearing recitation; as to *flexibility* of method and manner; as to the individuality of their pupils. But teachers are a very hard-worked class, and in justice to them they should each have fewer children to teach, before we censure them more for want of discrimination.

"Fewer studies at a time" would leave the mind clearer, the impressions in regard to the subject studied more distinct and vivid, and consequently the amount of perplexity and "worry" less.

It is earnestly to be desired, for the sake of health, that there should be a reform in the method of studying arithmetic, for want of which our children now waste an immense amount of time, while on every side we hear complaints of the want of time in the school-course to attend to studies of importance. This waste is caused from the universal attempt, in accordance with the standard text-books, to make children comprehend and retain in memory certain processes and reasonings before their minds are ripe for them.

The result is that they go over the same ground year after year, repeating in one grade of schools the work they did in the grade below, because it is found that they have not learned what they are supposed to know. The fact is that they *cannot* grasp and hold these matters till they are more mature; but in the natural course of development they will grow to the point, where they will accomplish in one-quarter of the time, and with far less effort, what they had before attempted in vain. In the interval they might be at studies suitable and delightful to them, for which, under the present system, "there is not time."

But, alas! it is not only time that is wasted, There is a worse waste of brain and nerve power, of temper and interest, a waste and a "worry," that falls alike on teachers and scholars. The lesson about which restless children most often *talk in their sleep*, is arithmetic.

Like things might be said of our common methods of teaching some other studies, but arithmetic may stand as a type of the rest.

"More training of the perceptive powers" is immensely needed, and would be a great improvement in mental hygiene, Such exercise of the young mind is in strict accordance with nature, and consequently eminently *healthful*. Girls especially need it. But we have not yet trained our teachers for such work; nor can we do so at short notice.

It is unnecessary to enlarge on the importance of cheerfulness in school. It is *mental sunshine*. There has been a great improvement in this regard during the last quarter of a century, and it will continue if we cast out "worry."

(*b*). As to physical conditions?

By "better ventilation,"	77
"more equable heating,"	27
"better seats and desks,"	17
"decent privies,"	8
"properly constructed school-houses,"	5
"fewer pupils to each teacher,"	10
"shorter sessions,"	17
"more frequent recesses,"	13
"more frequent change of position,"	17
"more freedom of position,"	4
"shorter and more frequent vacations,"	7

By "regularity in daily physical exercises,"	21
" daily vocal culture,"	6
" better lighting,"	14
" better tints of wall and better type,"	2
" better location of buildings,"	5
" military drill for boys,"	6
" sheltered play-grounds,"	2
" returning to half-holiday on Wednesday and Saturday,"	1
" establishing 'vacation-schools,'"	1
" removing girls at advent of puberty,"	2
" carefully kept register of Nos. and causes of absences,"	2
" adding to system out-of-door instruction,"	2
" more wholesome luncheon,"	2
" better drainage,"	1

An analysis of the suggestions under *(b)* gives as the physical reforms most generally required.

Better ventilation,	77
More equable heating,	27
Regularity in daily physical exercises,	21
More frequent change and freedom of position,	21
Better seats and desks,	17
Shorter sessions,	17
Better lighting,	14
More frequent recesses,	13
Fewer pupils to each teacher,	10

Defective ventilation is very generally and very emphatically complained of, and such expressions as follow are common: "We have no tolerable system of ventilation." "School ventilation is thus far a failure." "The air in our school-houses is simply execrable." "The stench of a primary school has become proverbial."

One of the school-houses presented in the Report of the State Board of Education, for 1873, as a *model*, large and expensive, on the warming and ventilating of which "much thought and care have been bestowed," was visited in December, 1873, and this is the report: —"I visited several of the rooms and found the air offensive in all to the smell, the odor being such as one would imagine old boots, dirty clothes and perspiration would make if boiled down together. The master says, he knows of no school-house where good ventilation is secured. Our superintendent of schools, says the same." "In the new *model* school-house, the hot air enters at two

registers in the floor on one side, and makes (or is supposed to make) its exit by a ventilator at the floor, on the other side of the room. The master said, the air was supposed to have some degree of intelligence, and to know that the ventilator was its proper exit."

The new Harvard School-house, in Cambridgeport, bears investigation better, the report on it being:—"The master says, the ventilation, though not perfect, is very good." "On the whole I should say, the ventilation is a success, considering the miserable failures which occur in the majority of cases."

123. "I do know, that in the ordinary construction of school-rooms, too little attention is paid to the number and arrangements of windows; to the mode of heating and the means of ventilation. The average hot-air furnace, with its liability to be badly managed, and its certainty to leak gas, is not fit to heat an apartment, which, in proportion to its size contains so many occupants as a school-room. The discoverer of cheap steam will be a benefactor. School-houses should have plenty of chimneys and capacious flues; and the efficiency of an open grate as a means of ventilation should not be forgotten.

"More attention to the height and form of desks and seats, and more thorough ventilation, are greatly needed. More care, especially with girls, in the matter of adjusting the clothing to atmospheric conditions is greatly needed. For instance, girls are in the habit of going into the open air from the school-room with no other clothing than that worn indoors, even in the coldest winter weather. Then some teachers are in the habit of opening the windows and letting a sharp current of air blow upon the heads of the children. One teacher said to me, 'I like to build a rousing fire, and then open the windows.'"

59. "Let the heating apparatus be as nearly perfect as may be, and do not let the feelings of the teacher be the only test of the proper amount of heat."

111. "The bodily harm done is to be traced almost exclusively to undue restraint, to bad air, and especially to that mode of heating the buildings in cold weather, which is habitually employed. In the Boston schools the drooping of children seems to me rather more marked in October and April, when a power in no way under the control of the teachers, roasts pupils and instructors alike in a heat without moisture, extreme enough for the bitterest winter's day."

127. "Constant ventilation and *equable* warming absolutely essential. Besides this, I always, even in our cold winter, throw open both outer and inner windows for a few moments in the run-out and after school. If *floors* and *walls* are warm, the cold air is quickly heated; 60° to 65° is the most healthy temperature. All plans of warming the room air instead of bringing in fresh are very bad."

130. "*Our buildings are not warm enough at the beginning of school*, and later warmth is obtained at the expense of pure air."

134. "The physical conditions of our schools are still lamentably defective in many respects. Systems of ventilation which read well on paper, are found to be in practice worthless. Both here, and in the modes of heating schools, there is room for indefinite improvement."

The difficulties to be overcome in ventilating school-rooms are very great, but not too great to be conquered by intelligence and money, both of which are at our disposal, but neither of which is willingly applied to the problem of ventilation by building committees, with whom, rather than with architects, the responsibility seems to lie. Much valuable information on this subject is accessible to the public in various treatises and reports, and the Report of the Massachusetts State Board of Health for 1871, contains an eminently practical paper on "The Ventilation of School-houses," which we commend to the careful consideration of all school committees and building committees.

At No. 5 Otis Place, off Brimmer Street, Boston, in the school-house of Mrs. C. B. Martin, may be found an instance of *completely satisfactory* arrangements for heating and ventilating, working well at all times, and supplying to the school-room, during severe winter weather, an atmosphere like that of June, in which one is warm enough at a temperature of 65° F. Exactly this system might be applied to public schools. It necessitates, in a building that would accommodate 150 to 200 scholars, an additional outlay of not more than $450, and perhaps twenty-five per cent. more fuel. It is substantially the same system which has been advocated by the best authorities for the past ten years.

But the trouble is, that every *tolerable* system of ventilation is expensive, and those having the matter in charge cannot bring themselves to lay out much money on that which will make no show whatever. Nevertheless, it is the fact that in our climate for seven months in every year, *fresh air* cannot be had within doors without paying money for it. Not only does it presuppose a somewhat expensive arrangement of ducts and flues, but it requires for the efficient working of these, when provided, more fuel than we like to pay for. Three things must be done: *first*, supply *fresh* air; *second*, warm it *before* bringing it into the room; *third*, get rid of it after it has been breathed *once*. In rooms heated by stoves,

or by steam-pipes in the room, the first and second demands cannot be met except by transforming them into "portable furnaces." To meet the third, requires both larger, more numerous, and differently placed openings and ducts than are to be found in one school-house in a hundred, and, in addition to these, a shaft or flue of ample size, and *well heated.* And these all cost money. But then pure air is a *necessity to health.* No State or town can afford to allow its school children to be slowly poisoned by breathing foul air. If we are wise we shall be less lavish of expenditure on showy exteriors and lofty halls, and more ready to spend on thorough ventilation. Nay, we shall insist on the latter at whatever price. In every school-house which cost $20,000, enough might have been saved by making the ceilings two feet lower, to pay the cost of supplying the building with pure air, while at the same time the labor of going up stairs would be sensibly less.

But the best apparatus needs vigilant care and inspection. Strange liberties are sometimes taken with ventilators and cold-air boxes. They have been altered into pigeon-cotes, hen-houses, rabbit-hutches. They have been boarded over in Massachusetts as well as in New York City, and so remained for months, perhaps years, before a faithful examination detected the cause of offence.

No "damper"—*i. e.*, valve for diminishing the calibre of the smoke-pipe—should be tolerated in any school stove or furnace, but, on the contrary, the amplest means of escape should be provided for the unconsumed gases. Even the device of cooling the smoke-pipe by admitting to it air from the room or the cellar, is to be regarded with distrust. It should always be combined with a vertical partition for a foot or more up the smoke-pipe, to prevent the immediate mingling of the cooler current with the products of combustion; and even then the temperature of the pipe must be jealously watched, lest it become too cool to "draw" well.

As to the practice of ventilating in winter by opening windows, we say, in the words of Dr. Angus Smith, "though foul air is a slow poison, we must not forget that *a blast of cold air may slay like a sword.*"

It seems to be forgotten that the old-fashioned open fire is

a very efficient means of ventilation, and might be used for that purpose in moderately sized modern school-rooms. Excellent furnaces can be and *are* made of soapstone and brick, without an inch of iron heating-surface, which furnish a perceptibly purer air than the ordinary furnace, as do also some of the furnaces made of *wrought*-iron.

"More equable heating" would be very much promoted by good ventilation. Like that, it is impossible in school-rooms warmed by close stoves. Double windows on the cold side of exposed rooms do much to promote it. The thermometer, not the teacher's sensations, should be the test of temperature, and there should either be two in the room, or the position of the one in use should be varied. It is a very useful and instructive experiment to apply it occasionally to the neighborhood of the floor, and obtain the testimony of science, as well as sensation, to the existence of "a lake of cold air" there. Finally, equable heating is much better secured by using a *large* heating apparatus, and not trusting the care of it to a boy.

References.—For ventilation and heating, see "Leeds on Ventilation." "Mass. Pub. Doc. No. 5, 1865—House." Report Mass. State Board of Health, 1871: paper on ventilation of school-rooms, and paper on air and its impurities. "Trans. Mich. State Med. Soc. 1873: papers by Dr. Hitchcock and Prof. Kedzie." "Anthracite and Health": George Derby, M. D., 1868. Boston Daily Advertiser, June 29th, 1869, same subject. Publications Mass. Med. Society, Vol. 3d, No. III., 1871.

"Decently kept privies" are the exception, the rare exception, in school experience. These out-houses are often so foul as to repel the more decent children from resorting to them as long as they can avoid it,—by which delay health is of course injured,—and when they connect with the school-house, the poisonous stench from them is often perceptible in the adjoining passages and clothes-rooms, and must mingle, less perceptibly, with the air of the school-room. Under such circumstances, they should have special and powerful ventilation, and under all circumstances they should be inspected *daily*, and defilement of them should be treated as an offence against decency. By perseverance in this course, a better public sentiment could be formed in school children, which would, before long, spread to their elders. It would

be perseverance in a very difficult and disagreeable duty, but one of vast importance. Finally, great vigilance should be maintained to see that, under no circumstances, does the wash from the privy or sink work into the well, as it may do when least suspected, and by indirect and hidden channels, or by surface-drainage, with the result of making typhoid or dysentery prevalent among the children of the school. An instance of this occurred in Wakefield, in 1872, where Dr. S. W. Abbott mentions that he saw "a dozen cases of typhoid arising from this distinct cause, viz., a sink-drain leaking into the well."

The use of earth-closets, or of dry earth, might often be of great value in remedying the evils in question; but great thoroughness and no little intelligence are necessary to make the dry-earth system a success. It has been used for more than a year in the Dorchester high school, and with success, as I learn.

145. "There is an opportunity for the doing of almost incalculable good if some improvement can be suggested in regard to the privies. It is true they are not worse in the school-houses than at the homes of children; but there is painful need of a radical change in the habits of whole communities in this respect. It is possible that, if the better sentiment of the larger cities in these matters could be shown to country people by the arrangements for the school-houses, the wants at home could be met. The exposure to which almost every woman and girl in New England is subjected, outside the very narrow limits within which water-closets are used, during every winter of her life, is, in itself, nearly sufficient to account for the proverbial ill-health of New England women."

"SHORT AND MORE FREQUENT VACATIONS." "VACATION SCHOOLS IN LARGE TOWNS."

104. "The present tendency towards throwing the relief time of the year mainly into a single vacation, though so convenient to teachers and to wealthy families in our cities, should be strenuously resisted."

112. "Poor children in cities are much better off in nice school-rooms, with light tasks, than in their homes or in the streets."

107. "I am satisfied that many children are seriously injured by exposure and excessive exercise in vacation, who would have escaped illness if they had been obliged to pass four hours in the school-room right through vacation. The atmosphere of the school-room is better than that of many of their homes, and most of their tasks are, in themselves, an amusement."

"More frequent recesses" are called for on very much the same principle as are "more frequent changes and freedom of position"; viz., the need felt by every young creature for frequent change of position and occupation. At the same time comes the opportunity for better air,—both in the playground and in the rooms,—it being often safe to open windows in recess, because the children are then in motion and free to go where they are the most comfortable. And it is no small matter that these recesses allow children to attend to the calls of nature, so frequent and imperative in little children (and in some who are older) as to lead to not infrequent distress and mortification.

Were these recommendations to be adopted it would work a revolution in our system of vacations. It will appear on reflection that the system is now adapted to the wishes of the teachers and of the wealthier families whose children are at school. But a very large majority of the children in the large towns and cities cannot go away into the country and enjoy its summer delights for weeks together, but must swelter through the long hours in the streets,—now in mischief, now in obvious danger, now listless, *always* in worse sanitary circumstances than if they were in decent school-rooms with moderate lessons. Our *duty* is to provide vacation schools of some sort for the children on whom these evils fall most heavily, placing over them teachers who have not taught through the preceding term.

And there seems abundant reason for making these vacation schools *industrial* on the half-time system, since it would not interfere with the present system carried on in term time. Such schools, together with half-time schools for factory children, under a stringent law, would do incalculable good, and would furnish reliable data for determining the propriety of applying the principle to the present public schools.

Whether the mental and physical health of nine-tenths of our public-school children would not be better if the vacation weeks were less massed than at present, and distributed more in accordance with the principle laid down for arranging recesses; viz., the great need, during childhood, of frequent *change* and relief from protracted occupation, is a question

which calls for careful examination. The result might be that many advocates for it would join the seven on our list.

The same arguments, *mutatis mutandis*, might be repeated in favor of returning to the old system of the half-holiday on Wednesday and Saturday instead of the whole holiday on Saturday, now so prevalent.

Fewer Pupils to each Teacher.

The need of this reform is very widely felt, less often however for hygienic than for educational reasons. Yet the highest interests of the two go hand in hand in this as in most reforms. Less crowding, less routine in discipline and instruction, more explanation and consequently less blind, perplexed groping over lessons, more inspiring, animating influence from teacher to pupil, lifting and attracting instead of pushing and spurring,—these changes, translated into common hygienic phrase, mean better air, cheerful enthusiasm, less worry; and they would become more possible if each teacher had fewer pupils.

42. "I want to say that our school-rooms are too crowded, that the teachers are too few for the number of scholars, so that the children are taught as classes and not as individuals. The moral influence of the teacher is reduced to the minimum. No teacher ought to have more than twenty pupils to teach at once, and then they should change rooms frequently. I would prefer fifteen to twenty pupils. I have been teaching young ladies alone for fifteen years; but for fully fifteen years before, I had pupils of both sexes, beginning with the primary school and ending with the charge of a high school, and I have answered all these questions from my whole experience. If I could do anything to prevent the massing of pupils in our public schools, or to increase the number of teachers, to make more intimate the personal relation between teachers and pupils, or to diminish the tendency to show and public display, and to increase the thoroughness of training of individuals as well as classes, I should feel that I had done things most needed for the improvement of our schools."

The reasons for recommending "shorter sessions" have been sufficiently set forth under Question VI.

Women on School Committees.

This important reform may be considered as fairly started and certain to be generally adopted. Its advantages are too

obvious to require to be insisted on here. If the courts shall decide that women cannot under our state constitution have the same legal standing on the school committee as men, they can nevertheless be made advisory and visiting members, with the certainty that they will see many things which now escape notice, and suggest remedies for evils which are mere perplexities to committees made up of men alone.

Properly Constructed School-houses.

For information with regard to the construction and cost of existing school buildings in Massachusetts, which are considered particularly commendable, both in cities and in towns, together with plans and estimates for the benefit of towns, which may have such building to do, the reader is referred to the 36th Report of the State Board of Education, pp. 87 to 148. In the same paper, pp. 112–116 may be found statements of the degree to which unsuitable buildings still prevail, as well as references to previous reports of the same tenor, and on pp. 81–83 of the same volume is another report by a special agent of the board of education, who investigated the condition of schools and school buildings in the four western counties. He visited 368 schools in 73 towns, and reports that "the *larger number* of the schools are kept in houses either badly located, incommodious, poorly furnished, inadequately lighted, or without proper means of ventilation."

80. "We of the larger and wealthier towns know little of the poor apologies of schoolbuildings in the remoter and poorer. Read in the last report of the board of education Mr. Walton's account of some in western Massachusetts, and then supplement it by visiting the school-house in North Adams, on the Hoosac, where the children of the miners congregate, *one hundred and twenty* of them under one teacher, in a room 30 × 30, with eight-feet post. No words are adequate to describe its aerial nastiness."

To the suggestions of the agent of the board of education, it seems important to add these: School-houses are often made too large; *i.e.*, made to include too many scholars; they are often made too high,—two stories are better than three, one story better than two; the rooms are often *too high in the walls*, a fault which makes them hard to heat, and neces-

sitates long flights of stairs, to ascend and descend which many times a day, is not only laborious but mischievous to all the older girls and to every feeble child, while the height is not required for ventilation. Again, ventilation is *not* sufficiently provided for in the plans there offered. For better means, see Report State Board of Health, 1871. As to lighting, see the present paper, under Question IV.

It has been a gain to school hygiene that PHYSICAL EXERCISES have been so generally introduced into our schools; but there is a great tendency to irregularity in the practice of these exercises, and not unfrequently they fall into disuse. Theoretically, their great importance is admitted; while practically, the time necessary for them is grudged as so much taken from the time of study. The fact is, that spirited and suitable light gymnastics promote instead of hindering study, because they relieve tension, draw off nervous irritability, equalize circulation, deepen respiration, and return the children to their books renewed in mind as well as body, and capable of attention and application, which were impossible to them five minutes before. But these exercises should be a *regular* part of *every* session in *all* schools, and in the younger schools should occur oftener than once each half-day. If this were done regularly, intelligently, conscientiously and with spirit, it would effect a distinct improvement in the physique of the pupils in every grade of our schools. What is to be seen at Amherst College as a result of systematic gymnastic teaching and practice, would be observed in the schools, and in a few years we should have progressive physical improvement from primary to high school, instead of the physical deterioration which is now too often evident by the time the higher grades are reached: provided, that we at the same time cease to *worry* the children.

Several "correspondents" insist on the superiority of *voluntary* physical exercise over that which is stated and required, and what they say is very true; but it is, nevertheless, a mistake to suppose that the desired result can be attained, except under exceptional circumstances, by leaving these exercises to the tastes and instincts of pupils. In the common schools, where study as well as recitation is wholly or

mainly carried on in the school-rooms, it seems evident that exercise must be stated and required; and in the higher schools which prepare for college or for special occupations, it can even less safely be left to the good sense or tastes of the pupils. For as the studious purpose grows stronger, the childish love of play and frolic grows weaker; as study demands more time, sedentary habits grow apace, and the relish for air and exercise wanes, though the need of them is greater.

The indirect, but potent, influence of all educational institutions where physical exercise is ignored, is to depreciate and discourage it, and the results are disastrous to health just in proportion as a student catches the tone of the place. Inasmuch as the higher schools, academies and colleges, not only exert an influence on their own students, but, through them, on all the common schools (for which they furnish teachers, committees, superintendents), inquiries have been made of seventeen of the leading ones in Massachusetts, as to their attitude toward physical culture among their students. It appears from the answers furnished, that in Amherst College alone physical culture is a recognized part of the course of instruction, with a regular professorship, filled by a fully educated physician, who is an experienced gymnast. Attendance on his instruction is required as much as on that of any other members of the faculty. Prizes are offered for excellence in this department, and interesting statistics in regard to it are printed and circulated. Cambridge University and Williams College have each a good gymnasium, freely open to their students, and athletic sports in the open air are *encouraged*, as they are at Tufts College, which is without a gymnasium. It is probably true of all the colleges, as it certainly is of Harvard, that "the physique of the undergraduates has conspicuously improved during the last twenty years." At the Agricultural College there is, of course, no lack of exercise, and the same may be said of a portion of the students at the Worcester Free Institute. Four leading academies for boys all furnish facilities; two of them having military drill, two others fine gymnasiums; in one, gymnastics are taught forty-five minutes each day.

Of the three leading academies for girls, one requires either

a daily walk of a mile, or half a mile's walk and gymnastics; in addition to this, about one hour daily of domestic work; another requires half an hour's walk A. M. and some exercise P. M.; the third requires light gymnastics daily. Of the four state normal schools, one has a gymnasium and bowling-alleys, besides light gymnastics twenty minutes each day; another has daily frequent light gymnastics; a third, free gymnastics or recess after each recitation; a fourth, "one hour's daily exercise required." And it should be added, that in the girls' schools these exercises are not required at all times, without discrimination as to periodic inability.

It will be observed, that the position of these influential establishments toward physical culture is decidedly encouraging, and may be expected to become still more so, till this branch of education attains its proper place, and the vigor and grace and development of the body shall be as distinctly considered and provided for in our educational system as that of the mind. Then the studious and the sluggish will not be left to neglect their health, and all will be trained to enjoy exercise, and to rejoice in the *play* of limb and lung and sense. To bring about this result in any school, it is evident that we need the influence and *example* of teachers who not only believe in, but *practice* and *enjoy* physical exercises in-doors and out.

81. "By not *requiring* school gymnastics of that class of scholars who have domestic or horticultural gymnastics at home. Girls are not in a suitable dress at school to practise gymnastics, with or without rings, lances or dumb-bells, without great injury to themselves and their clothes."

128. "Full one-third of the time should be devoted to such exercises as put the mind in full possession of the body: military exercises, gymnastics working and even dancing."

REFERENCES.—See Edwin Chadwick, in Social Science (Brit.) for 1860, on Drill in Schools; Physical Culture at Amherst College (N. Allen), 1869; "Amherst Student," April, 1873; "Vox Populi," April 9, 1873.

"Better Location of Buildings."

Good drainage, dry soil, tolerable shelter from the coldest winds, aspect as regards sunlight, these are matters too little considered when the site of a school-house is

determined. At the same time more thought might well be given to obtaining sheltered and sunny yards and play-grounds. In comparison with the foregoing, it is of little consequence whether the school-house be parallel with the street, or symmetrically placed on the lot of ground, or whether it occupy a conspicuous place. Yet these considerations are the governing ones in locating our school-houses, although they look merely to the effect which the buildings will produce on those who consider *externals* alone, and have no regard to the essential matter of sanitary fitness. In comparison with these sanitary questions, even the consideration of a location near the centre of the school district becomes immaterial.

"CAREFULLY KEPT REGISTER IN EVERY SCHOOL OF THE CAUSES AS WELL AS THE NUMBER OF ABSENCES FROM SCHOOL."

It being already very generally the rule to require a written "excuse" from the parent of a child who has been absent, stating the reason for his absence, it seems quite practicable to extend the requirement sufficiently to secure a statement of the nature of the sickness, where sickness has caused the absence. It is certain that if this were to be insisted on, we should, in five years thereafter, be in possession of a most valuable mass of statistics, from which we could reason on school hygiene with a certainty which we cannot now attain. And we should consequently be able to offer a very satisfactory basis for legislative action on this subject.

SANITARY INSPECTION.

Every city should have a sanitary inspector and instructor of schools, who should be a physician.

Every town board of health should have among its number a physician, whose duty it should be to pay a monthly visit to every scholar in town, and make a monthly sanitary report to his board, and a yearly report to the town and to the State Board of Health.

Of sanitary matters physicians are confessedly the best judges; their professional interest and enthusiasm would lead them to undertake labors in such a cause, which could not be expected from men of other occupations, while their

acquaintance with the amount and nature of disease prevailing in their towns from month to month would both furnish and obtain valuable illustration in connection with their official school inspections. By *reporting* their observations, there would be secured the *record* of what would otherwise grow more and more indistinct and fragmentary if trusted to memory and to verbal statement. Upon the local boards of health, and upon the towns, something definite and permanently open to reference, in relation to school hygiene, would be brought to bear. Public attention would be drawn to whatever mistakes and evils of this order might be shown to exist, and when this great point can be gained, the evils will certainly be abated.

Of the value of such reports to the State Board of Health it is unnecessary to speak. Of course the board of education would be equally benefited. It should be a part of the function of this medical member of the board to assign a *time* of *quarantine*, before the expiration of which a child who has suffered from one of certain *specified* contagious diseases shall not be allowed to attend school. In this way the prevalence of measles, scarlet fever, etc., might be diminished.

REFERENCE.—See "London Lancet," Nov. 22, 1873.

The effect of some of the changes proposed on the 8,448 teachers of our public schools is too serious a matter to be forgotten in this discussion. They would be as great gainers as their pupils by better ventilation, heating, lighting, etc.; by regular physical exercises; by changes which should recognize the law of periodicity in woman; by the diminution of all influences which cause friction in the working of schools. No doubt many of them would find their work increased for awhile by the loss of the spur of emulation and vanity in school; but this disadvantage would be temporary, and once things were adjusted to a more wholesome method, they would feel the relief. Whether they would not suffer permanently by the substitution of shorter vacations for the long one in summer, is not clear. There can be no doubt, however, that their work would prove far less wearing if the various reforms proposed were to be brought about.

One word more in closing, to avoid the misapprehension so likely to arise from prolonged attention to a discussion of the evils of any occupation; viz., that the community would be better off if no such occupation were tolerated in it. The schools of our State are an incalculable blessing to the State and to every citizen. They are neither "slaughter-houses" nor "prisons." It is because they are so precious that it is worth our while to scrutinize them so closely, and never to cease our efforts to improve them.

THE

WORK OF LOCAL BOARDS OF HEALTH.

By AZEL AMES, Jr., M.D., of Wakefield.

THE WORK OF LOCAL BOARDS OF HEALTH.

Although for many years there has existed, upon the statute-book of this Commonwealth, provision for the creation in cities and towns of independent boards of health, and more or less information and authority for their action, the absence of prominent special causes for interest therein has made, with small exception, all inoperative, and the serious exigencies of the last few years have found the would-be movers in these vital measures uninformed as to their powers and their work, while, to the advanced intelligence of the special observer in this field, the provisions of law seemed often inadequate or wrong.

In the limits of the following review of the peculiar work and observation which fall to the lot of local boards and officers of health, no more can be attempted than to outline, as clearly as may be, the routine duty of those whose efforts will not alone promote the immediate well-being of their various localities, but may prove invaluable in making up the data for future knowledge.

The writer well recollects the eager search of his associates and himself for any items of special instruction, on assuming the work of a local board of health, and the reply of the Secretary of the State Board to an appeal for a code of "health regulations"—"I know of none, and you will be obliged to create them,"—a reply that resulted in the framing of the code published in the report of the State Board for last year, and which has been adopted, in full or in part, in very many towns in various parts of the country.

It is hoped herein simply to give to those who have, without special preparation, been called to the discharge of the responsible duties of health officers, whatever benefits the writer may have derived from a somewhat eventful experience in a like capacity, and from an earnest study of the

subjects involved. The manifold, more intricate and peculiar concerns of the public health of cities, coming as they do under the provisions of special ordinances, it is not intended here to consider, except in so far as they may be analogous to those of towns, and are under the operation of general law.

[Chap. 1.]

ORGANIZATION.—While the statute of Massachusetts provides for the election by a town of an independent "board of health," to consist of not less than three, nor more than nine persons,* it also specifies that instead there may be chosen "a health-officer," and in the event of failure to choose either, the duties of such offices shall devolve upon the board of selectmen. The grave error of this law lies in its failure to make *obligatory* upon every town the choice of a *board* of health, the reasons being many and obvious why a board is preferable to a single officer, and equally so why the board of selectmen is inadequate to the performance of the special work.

The composition and organization of a board of health are by no means the least important of its considerations, and it is evident that there should be brought to the peculiar work it undertakes the largest and best possible medical knowledge and judgment.

In no town where there reside one or more physicians of any respectable standing, should there be a failure to secure the services of one, at least, upon the board, and in all cases where possible, a physician should be the secretary and executive officer. The qualities preëminently required for an officer of health are sound judgment, care in investigation, firmness, fearlessness and *tact*. Given a board composed of citizens possessing these qualities, having as a member an educated and active physician, and preferably a sound lawyer, and the unfavorable hygienic conditions of a town will unfailingly speedily lessen. The following conditions, in brief, should, it is believed, attach to a board of health to secure its greatest efficiency.

It should consist of five persons, chosen for their qualifications.

* Gen. Stats., chap. 26, sect. 1.

It should embrace, if possible, a physician, engineer, lawyer and merchant.

Its medical member should be its secretary and executive officer.

Its members should be elected for five years, the term of one to expire yearly.

Its secretary should have a fixed and adequate compensation.

The fullest records and files of its transactions and correspondence should be preserved.

The territory of the town in which it operates should be divided into districts, and certain members be made responsible for the oversight of each district.

It should frame and put in force as complete a code of health regulations as possible, based upon the provisions of law, so far as any may exist and apply.

Health Regulations.—By the terms of the General Statutes,* a board is empowered to "make such regulations as it judges necessary for the public health and safety," and a penalty of "not exceeding one hundred dollars," attaches to their infraction. It will be observed that in this general clause resides all the authority that attaches to such regulations as a board may establish, except in so far as these regulations may be founded upon other special sections of law providing for particular matters or conditions. It is to be regretted that the force of the general clause is sometimes rendered in great part inoperative, by the definite determinations of individual laws. It has happened to the writer to meet with the following complicated and unfortunate condition of things. By one of the health regulations of his town, vaccination was, in conformity with law,† made obligatory, but in a certain case was refused. Recourse was had to the process of law indicated by the statute, and the justice before whom the complaint was brought, in view of the aggravated circumstances, would have imposed a fine of some *twenty* dollars or more, *as a penalty for the infraction of a health regulation* requiring vaccination, but found himself barred

* Chap. 26, sect. 5.

† Chap. 26, sect. 27.

from so doing by the special section,* which places the penalty of neglect or refusal in the sum of *five* dollars. The ruling of the justice was affirmed by the attorney-general, in a letter to the writer, in the following words: "A local board of health cannot by regulation control or enlarge the operation of the statute upon the same subject, so far as penalties are concerned." It is evident, therefore, that in the framing of regulations, it is desirable to found them closely upon the most relevant law, and in case of prosecution, to see that the case is not weakened by the imposition of an illegal penalty, and failure of punishment ensue.

It is doubtful, too, if the ruling of the attorney-general, in regard to the powers of health regulations, does not extend to provisions of law other than penalties, and while it might be the judgment of a board that every child should be vaccinated at *six months* of age, so long as the statute† fixes the least limitation at a day under *two years*, it is doubtful if a regulation requiring earlier vaccination would have any force or validity.

It will hardly escape the attention of a competent officer, that *all* regulations issued by a board, whether made as a code at its induction into office, or from time to time subsequently, *must* be published in a newspaper, if there is one in the town (by preference, at least three times), or if not, by "posting." An instance is on record, however, of the nonsuit of a board in a case in court, from its inability to prove that its regulations had been legally published. While the existing health-laws of this Commonwealth are still in some respects conflicting and difficult of interpretation, they have, as amended in late years, been found adequate, when action has been based upon careful consideration of said laws.

Especial attention is called to the regular requirements‡ of procedure in the issuing of orders for the abatement of nuisances, etc., not a few failures to establish prosecutions having occurred under the knowledge of the writer, in various localities, from neglect in this respect.

All orders should be in writing.

* Chap. 26, sect. 28.
† Gen. Stats., chap. 26, sect. 27.
‡ Gen. Stats., chap. 26, sect. 9.

They should be served by a competent officer in the prescribed manner; and

Proper time should be allowed for the voluntary action of the offender.

[Chap. 2.]

Board Work.—The three definite heads under which the labors of a local board will be put forth, are—

The Prevention of Disease;
The Restriction of Disease; and
General Sanitary Observations.

Under the caption of the Prevention of Disease, we come to the consideration of the most obvious causes of public ill-health, and some of these, as requiring most frequently the official cognizance and action of the health-officer, it is proposed to review somewhat in detail.

Privies, etc.—Prominent among the causes that contribute to the ill-health of communities, both directly and indirectly, is the imperfect manner in which human excreta are at present disposed of. For generations the vaults, out-houses and latrines of common use, have existed, reproaches to decency, "a reek in the nostrils," generators of disease, and annoyances that only a seeming necessity made tolerable. By far the largest percentage of complaints made to local boards are of these sources of discomfort and disease, and the regulations that bear thereon require to be ample and stringent.

The regulations affecting privies, established by the board with which the writer has been connected, are as follows:—

Reg. 1.—No privy or water-closet, not having a water-tight vault, or such vault with a water-tight drain, to convey the contents to a proper reservoir, shall be established within two rods of any well, spring, or other source of water used for culinary purposes; and such reservoir shall be at least two rods from any such water source. Provided, however, that earth-privies or closets, where dry earth or ashes is daily added to the deposit vaults, in sufficient quantity to absorb all moisture, and the entire contents are removed weekly, may be so established.

Reg. 2.—No privy-vault shall open into any stream, ditch or drain, except common sewers, or in the manner specified in Reg. 1.

To which is attached a regulation, requiring that within certain limits (the thickly populated section of the town) no night-soil shall be removed until 10 o'clock at night. It early became the unanimous opinion of the board, that these regulations were insufficient, and that further safeguards for an agency capable of so much mischief, were requisite. It was determined that the character of the soil upon which the shallow-vaulted privies stood, should become a much more influential factor in the reckoning of the possibilities of water contamination therefrom. In two instances of complaint, where the privies alleged to be the sources of contamination were located at a distance of over three and a half rods from the wells fouled (with the ground at a gentle incline toward the well in one case), an examination showed the superstrata to be a sandy loam underlaid by a coarse gravel and sand, forming an admirable percolator for the noxious fluid of the vaults, which an analysis of the water showed to be undoubtedly present. It is an interesting fact in this connection, that after the vaults were removed, and the wells had several times been filled and pumped out, the water retained sufficient of the offensive influx to be obnoxious to the taste, and although now in use, of course cannot be pronounced free from the danger that has invaded it. Nothing cries more loudly for relief and reform, than the condition of things in this regard in the cities and larger towns unsupplied with sewerage or an aqueduct water-system. The proximity of wells and cisterns to vaults, cesspools and open drains, is as dangerous as sickening. It is doubtful if, in the heart of the town in which this is written, there is any point at which some well or cistern is not within sixty feet of some vault, cesspool or open drain, and subject to the intercommunicating channels of overflow, burrowing animals,* or broken drains. In hardly any way can health-officers more surely promote the health, wealth, comfort and convenience of their neighborhoods, than by introducing to general use the dry-earth system in some of its forms.

There exist to-day upon the line of the Boston and Maine Railroad, several stations in which the waiting-rooms are ren-

* Braithwaites' Retrospect, July, 1871, p. 39.

dered so offensive by the effluvia from the underlying or adjacent vaults, as to be positively repulsive and infamous. By the abolition of this old system of receptacles, and the introduction of any of the best known styles of earth-closets, this evil might be readily removed, and it becomes the duty of the boards of health of these respective localities, to interpose their authority in this behalf.

There exists in this immediate vicinage an extensive factory, employing more than a thousand operatives, where the buildings exhibit their tiered privies, blackened with the foul vapors that arise from their vaults, indicative of the pestilential atmosphere those who use them must endure, and the deleterious influence they must exert upon those employed in their vicinity, to say nothing of the vast waste involved in the ultimate washing away by a sluggish stream of the valuable product, ascertained to have by actual computation, a fertilizing value of over $2,000 per annum, in its crudest form.

To the subtle but powerfully injurious effects of such immediate surroundings as these, superadded to the confinement and devitalizing influences of this class of labor, is no small degree of the low health and mortality of factory operatives due, and their features and remedy are not less important than legitimate objects of consideration for local boards of health. It will be interesting to note under the discussion of *sewerage*, the relationship it has been sought to establish between the stream into which the contents of these factory privies are discharged, and the domestic water-supply of a neighboring city.

The experiments of Rothschild and others, sufficiently attest the profit that, under good management, may be reaped from supplying dry earth to the inhabitants of villages for closet use, and removing it subsequently for fertilizing purposes. Boards of health, having opportunities of so doing, or in the neighborhood of popular seaside or other resorts, will do well to consider the possibility of securing therefrom both health and pecuniary return. It should be made a requirement of health regulations in every town, that all removals of night-soil should be during the night, between ten o'clock and four, and that all apparatus employed,—as wagons, buckets, etc.,—should be thoroughly water-tight.

Drains, Sewers, etc.—Only less prolific sources of complaint to guardians of public health than privies, because more hidden and obscure than they, sewers and drains are the fruitful cause of a vast total of disease and death in every community. Most subtle while most potent in the virulence they exhale, their dangers have been less regarded than those more patent, and wherever the investigations of sanitary science have gone, there the lesson of their power for evil has been taught. Advanced knowledge of their contaminating influences creates only a doubt whether to place foremost for destructive power, the possibilities that inhere to their intended flow, or those that attach to the fatal gases that escape therefrom to disseminate their poison through our dwellings.

To reach, as is desired, the effects of drains and sewers, such regulations as the following are not sufficient:—

"No sewer-drain not water-tight, shall pass within two rods of any well or other source of water used for culinary purposes.

"No sewer-drain shall empty into any lake, pond, or other source of water used for culinary purposes, within the limits of this town."

By the term sewer-drain, it was intended to indicate any drain conveying excrementitious or other radically foul, noxious or impure matter; but not a sink-drain or a cellar-drain as ordinarily used. This distinction in favor of sink and cellar drains grew out of the conviction that while a condition unfavorable to health might possibly, and not improbably, result from the addition of their discharges to the waters of a well, typhoid fever or other grave disturbance would not, that typhoid *could* not occur; and that the cases would probably be few where a sink-drain would be suffered, open as they generally are to observation, to run in dangerous proximity to a well. Never was conviction more erroneous, never confidence more ill-placed or beliefs unsound, never refutation more complete and convincing.

The convictions above expressed being held, only a recommendatory clause was added to the foregoing regulations in reference to the drains of sinks and cellars, by which it was advised that soil about the vents of such should be frequently renewed, and in the vigorous inspections of town territory, beyond the removal of sink-drains, when opening upon the public streets, no attention was paid to this class of nuisances.

Early in the summer of 1872, the physicians of W—— had their attention attracted to a sudden and considerable increase of the number of cases of typhoid fever under their observation, and inquiry revealed the fact that while the patients were of varied employments,—as carpenter, mason, teamster, laborer, etc.,—and all resided in different places, they had all occasion, while employed in a certain locality, to drink from one pump, which, standing out of doors near an Irish dwelling, was convenient for use. An investigation showed that an originally insufficient *sink*-drain ran from this dwelling within some seventeen inches of the well, to a bank some twenty feet beyond and below, and that this had broken directly opposite to, practically in contact with, the walls of the well. A careful and thorough inquiry into the uses of the sink brought out no admissions that it had been employed for other than its proper service. Indeed, the statements which were made and believed were to the effect that no excreta, fluid or solid, had ever passed through it; that there had been no known case of typhoid fever in the house; that no slops had been emptied in the vicinity, and that the premises were newly occupied. In all, there occurred *nineteen* cases of more or less well defined typhoid fever in persons who had drank from this well, and knew no other cause of illness than this, and the number and circumstances were such as to forbid the thought of mere coincidence. There were no deaths resultant, but severe mania (in two cases long continued) was generally manifest, the abdominal symptoms presenting about the usual proportions of gravity and mildness. A striking and amusing feature of the investigation, was the indignant and confident rejoinder of the owner of the property on being reproached for the carelessness that could locate so insufficient a drain in such proximity to a well, in the words, "Why, doctor, that drain don't go within *two feet* of that well!"

Since that experience, no doubt has been entertained of the necessity for regulations as stringent for sink and cellar as for sewer drains, and the belief that personal interest would secure the proper location of drains in reference to wells, was abandoned when, later in the season, some thirteen drains of one kind or another, but none of them water-tight, were removed from almost equally dangerous relationship to several

sources of family water-supply. Indeed, it is doubted if it is possible to frame regulations that will cover the requirements of sewerage control. To the vigilance of local authority, the inculcation of the vital importance of safe provision in this respect, and a general increase of knowledge, we must look for the condition of things so desirable.

The opening of sink-drains from tenement or other houses or manufactories upon the public street, is an offence against sanitary law and common decency that should never be permitted, and yet in every manufacturing village these agents of ill-health and discomfort, by scores, call for the intervention of the local boards of health. In the crowded sections, occupied by the tenements of the laboring class, it has frequently been found of advantage in lessening the mawkish odor of drains, to purify the channels with copperas, borax, carbolic acid or charcoal; and it is earnestly recommended to officers of health, that wherever they have an oversight of the construction of drains, they counsel the creation of facilities therein for clearing and purifying.

A frequent source of health-disturbance, and of even the gravest results, has been found in the sink-spouts which, foul and unsightly, so often descend from the upper stories of tenement houses, forming direct avenues of connection between the higher rooms and the cesspool below, through which the insidious poison of sewer-gas finds its way.

At a well-known institution in the vicinity of Boston, there have recently occurred two deaths of visitors, who, occupying an ordinarily unused apartment, were subjected to the fatal influences of sewer-gas, which entered their room through an open window, close by which ran a water-conductor, which had its lower end entered in the sewer, into which the contents of four water-closets were discharged. A loose joint in the conductor at this point, is said to have permitted the escape of the gas into the room continually, being prevented from escaping at the top by obstructions in the gutter. Virulent attacks of typhoid followed, to which both succumbed, and a lesson of grave importance should be drawn by sanitary inspectors therefrom.

The failure to provide a proper ventilating flue running from all water-closets, etc., through the roof of the dwelling,

has been the cause of death of many whose conveniences of home, for want of knowledge in their management, have become their unrecognized destroyers. It can hardly be doubted that in the not remote future the requirements of sanitary science will be so far admitted as to place our architects and builders under proper restraint, to the end that there shall be in their work, full recognition of established principles of hygiene.

The frequent breakage of sink and sewer drains near cellars, and the escape of their foul contents into them, is a source of danger that requires careful observation and prompt action.

It is useless to contend against the use of cesspools in a town, so long as no complete system of sewerage is provided. The work of a local board in reference thereto will be to insure that they are properly constructed and kept, and that they are replaced by sewerage, which, although the costliest of all sanitary appliances, is also in the end the cheapest and most indispensable. In the generality of suburban towns two forms of cesspools prevail; viz., one, so constructed as to permit of the percolation of the fluid contents through the partially open sides and bottom thereof (and this is by far the most common); and another, in which the walls are so constructed of cement, brick, or other material, as to retain all the contents received. Of this latter variety there are far too few. The almost universal form of cesspool, in many sections, is simply a pit of variable dimensions, dug in close proximity to the dwelling (both because it saves drain-pipe and is more convenient for the emptying of the slop-jar), its sides of earth being prevented from falling in by sundry corner-posts and loosely fastened boards or planks, the bottom being left open and the top more or less completely covered with planks and earth, an aperture being sometimes, but too rarely, left, for the escape of gas or the pouring in of waste. From such cesspools as this, arise a large percentage of the various ills of a community. Against such, local boards of health should wage eternal war. The openness which so recommends this style of pit (because thereby large amounts of waste are disposed of through a small excavation), and the

trifling cost of its construction, are the deceitful arguments that lure to danger and ultimate expense.

In an area of six rods square, in the centre of which the writer is now sitting, there are contained *one barn-cellar*, *four privy vaults*, *four sink-drains*, *two cesspools* (such as just described) *two cisterns* and *three wells*, and herein the wells are about equidistant from *all* the sources of contamination. The character of the soil, being a stiff under-stratum of clay, with clayey-loam on top, has alone prevented, in the two years this state of things has existed, most disastrous results from occurring, and that such must come in time none can doubt. When the overcharged soil has become permeated with the poisonous infiltrations of these several sources, its work of destroying will be no longer delayed. The evil of this condition of things is recognized and deplored, but there is no readily open avenue of escape. Property of considerable value covers or adjoins this area, which lies adjacent to one of the best streets in the town, and there is no land in which to more widely separate these evil agencies.

Sink water and waste must be taken care of in some way, while wells and cisterns must be had. The only hopes of relief from this distressing and dangerous state of things seem to lie in the early introduction of sewerage or water systems, preferably both, or the adoption by all interested of the largest possible use of the dry-earth plan, involving under such circumstances no inconsiderable labor, inconvenience and expense. Still the difficulty must be met, or disease is to follow, and inasmuch as this condition is also that of numerous areas of the closely populated town, it is evident that in general measures of relief the remedy must come.

The *close* cesspool, properly cared for and emptied, while primarily more expensive than the other, may be made a source of some return, and, rightly ventilated and its pipes trapped, will be free from the charge of contributing to disease. A serious inconvenience has, until recently, attached to the emptying of such close cesspits, as well as privy-vaults, often from their walled-in location and difficulty of access, and always from the character of their contents. A remedy for these difficulties is found in the new apparatus of the

Odorless Excavating Company* of Baltimore, which consists of a pump with peculiar valves, with hose, tank and furnace for the consumption of gases. This, as satisfactorily tested, proves itself capable of removing without disturbance, filth or stench, the contents of any vault or cesspool, however inclosed, provided a hose can be carried thereto. So valuable an auxiliary to the work of health officers will not fail of a ready welcome, if placed at a price that will enable our larger towns to possess themselves of it. It has long been recognized, that the price paid for the cleansing of vaults and cesspools was excessive, in view of the fact, that a real profit accrues therefrom in the night-soil itself. It is earnestly recommended to the boards of health of large towns, that a contract be made with some neighboring agriculturist for the removal of *all* night-soil for an official year at the best terms procurable, the value of the product being reckoned, and thereby a saving to each citizen be effected, the work to be responsibly performed, and the community be thus secured an agency for the performance of work which individuals often find it difficult to have done. In one case, within knowledge, where a board of health possessed itself of the needful apparatus and labor, a considerable profit accrued to the town by the conveyance of the night-soil to the outlying town farm, where it was composted, and ultimately sold to neighboring farmers.

The careful inspection of the drainage of cellars cannot be too earnestly enjoined upon local boards, and the construction and point of discharge of cellar-drains have been proven matters of no inferior concern.

A case is recorded, where a number of the inhabitants of a town, near one of our large northern cities, were seized with active malarial fever, occasioned, as was shown, by the emanations from the outlet of a cellar-drain near their residences, which drain communicated with the storage-cellar of a vegetable dealer. In the construction of sewers, it is believed to be a false economy which, for the sake of saving the expense of new pipe in subsequent possible examinations, *makes loose joints*, by which the escape of both fluid and gases is per-

* "Scientific American," Oct. 25, 1873.

mitted to contaminate water, soil and air. Frequent and rigid inspectors are the sole safeguards of health authority against the injury that must unfailingly result from overflowing cesspools, choked up drains and surface sink-spouts.

It seems hardly credible, but it is nevertheless true, that the city of Lynn is to-day an applicant for the control of the waters of Saugus River for domestic use, into which stream, as before mentioned, the whole excreta of a thousand factory operatives are discharged, as well as the dyestuff, waste and filth of the factories, and much offal, street-wash and refuse of the town.

Accepting, as we safely may, the findings of the Rivers Pollution Commission of England,* in regard to the impossibility of streams purifying themselves when polluted with sewage, it is evident that either the health officers of that city have not been consulted, or will be remiss in duty if they fail to emphatically protest against such water-supply. It is an interesting commentary on the value of non-medical testimony on these matters, that the city solicitor of Lynn declared before a committee of the legislature that *he knew* that this stream, sluggishly flowingly through six miles of peaty basin, often broadening into little ponds and receiving frequent additions of organic matter, would entirely purify itself in that distance.

A duty of no inconsiderable moment that falls upon public health officers, in part, is that of protecting, as efficiently as possible, lakes, ponds or other sources of water-supply within their precincts from the various pollutions that endanger. In several towns in the State, it chances that the sources of their aqueduct systems lie within populated regions, and are subject to greater or less disturbance from causes beyond local control, but upon health officers of such localities much will depend in preventing the drainage of streets, cellars and barn-yards from passing, unfiltered, into the domestic supply. The wash of arable land, the addition of decaying vegetation, the organic contributions of the natural water-shed, these it is difficult, and in the main impossible, to restrain or control, but wilful and heedless pollutions require the vigilance and action of local authority.

* Fourth Report State Board of Health, p. 97.

By a recent Act of the legislature, one of our large and prosperous towns has been granted the control of the lakes lying within its territory for public use and consumption; yet, into the largest of these, having a mean depth of only *twelve* feet, there now empty the wash of a long extent of public highways, the sewer-drains of several families, the leakages of nearly as many privies, the ground flow of three graveyards, and the accumulations of two brooks, into one of which the foul offal of a melting and rendering shop is allowed to drain from a side-hill sloping to the brook's edge, where it is weekly deposited. It is to such disregard of public rights that authority should give its most vigorous attention.

Fortunately for numerous localities, ample power is conferred upon boards of health for the draining or filling up of low, malarious lands, stagnant pools, etc.; but while health, and often comfort and content (the last prerequisites of health) require that a board should exercise its power in this regard, it must be certain that *health* really requires it, and *not* prejudice or personal desire. A larger amount of real moral courage is needed on the part of a health officer to refuse the requests of friends for such abatement of troublesome matters, when the judgment fails to indicate actual necessity for action, than is requisite to take in hand the abatement of a real nuisance when influence and wealth must be opposed.

House Offal, etc.—Another of the ever-present obstacles to health, which increases as civilization goes forward, is the waste and refuse of our homes and factories, the garbage of our kitchens and purveyors' shops.

In addition to the sore discomforts of the stench which arises from every family swill-barrel, dealers' refuse-tub, and fish-market, or the uncleanly condition of our yards where overflowing receptacles stand, or of streets strewn with fish-heads and offal from the dealers' carts, the decaying and poisonous substances involved are prolific of various types of disease.

Every local board of health should insist, by regulation and enforcement thereof, upon the possession and use by every family, and such dealers as require, of a water-tight and sufficient

receptacle for swill, capable of easy removal and provided with sufficient cover.

Ample provision should be made by the board for the regular and systematic removal of all garbage offered for removal in towns of such size as to require it. All garbage-carts should be water-tight and tightly covered.

All provision shops and fish-markets should be frequently inspected with reference to their disposal of refuse, the character of their stock and their general cleanliness. The cellars of houses and marketmen should be cleared each spring, and as much oftener as necessary, of all decaying vegetables, etc., and the cellars themselves be kept dry and well-drained.

The most stringent regulations and enforcement should exist in every town against the throwing of fish offal, butchers' refuse, swill, dead animals, slops or household rubbish upon the streets or lanes of a town.

No objectionable refuse, vegetable or animal, should be carted upon land without special permission and instruction from the board.

The regulation requiring the maintenance of a proper swill-receptacle should be made universal, operating even upon those who choose to feed the waste of their kitchens to their poultry or swine rather than have it removed by the scavengers of the board. Such feeding must, of course, take place without detriment to considerations of health, or it will become the duty of the board to further restrict or even to abolish. Frequent inspections, and the encouragement of reports by citizens of unwarrantable practices, are requisite for safety in this regard. The dislike, which is a part of a republican form of government, to interfering without necessity in the personal or property rights of the citizen, makes it desirable that the disposal of even the least valuable of his possessions should be left in his own hands, and throughout the administration of sanitary enactments, this is to be prominently borne in mind. The public right however, is dominant, and the same principle which is recognized in the right to confine the insane or destroy a rabid animal obtains in the prevention of harm to the public's chief interest, its health, by the sometimes rigorous provisions of sanitary laws.

It has been said that ample arrangement should be made

for the regular removal from residences, etc., of accumulated garbage. The cities and larger towns have generally recognized this necessity, and provided therefor; but their systems are not always available in, or believed to be the best for, outlying or suburban localities.

To secure even decent results, something more than the haphazard visits of individual scavengers is needed, and the creation of a proper outfit for the performance of the work by the board itself would be expensive, and is unnecessary. In almost every town, there may be found one or more individuals who, for either market or fertilizing uses, keep several swine, for whose food the swill-product of a town has a recognized value. In the section in which this is written, there are not a few farmers who, finding no profit in raising the hog beyond his manurial uses, if a corn diet is fed, are weekly hauling an empty wagon fifteen miles or more to Charlestown poor farm, where that city's collections of swill are stored, and buying a load at a dollar a foot; *i. e.*, for from one to four dollars, carting the heavy mass home, an equal distance, consuming often the time of a man and two horses for a day, and believing "it pays."

While the correctness of the belief is doubted, the value of this plan of utilizing this waste is readily admitted, and if the supply were obtainable nearer home it is easily understood how this method would "make money by saving it." It is all the more certain, moreover, that if, as these farmers claim, "it does pay," it will pay much better when the distance travelled is five miles instead of fifteen, and the time consumed half a day instead of the whole. It is therefore urged upon boards of health of towns of sufficient size to be disturbed by the accumulation of garbage, that they contract with some one or more of these swine-owners for the regular and cleanly removal of all swill, at a certain price per foot, or per year, or, if no better can be done, for the swill itself, though it has long been wondered why cities and towns, as the city of Chelsea, have been willing to pay to a contracting scavenger, a large sum per year in (addition to the material collected) for its removal, when the market value of the latter was well established and the demand equal to the supply. In one town where it was not believed that a sufficient amount

could be collected to pay for the labor, on the establishment of such an arrangement as that suggested, in addition to the great gain to health and comfort derived therefrom, sufficient return was gathered to pay for watering the principal streets of the town during the hottest of the summer months. It is believed that the same good results are possible to many towns throughout the State. By such a system of frequent collection and disposal, the evils of storage are avoided, and these, as existing at Charlestown, have required the attention of the State Board of Health. In the collection of the garbage, care should be insisted upon in covering carts, with a view not only to lessening the discomforts of the unsightliness and effluvia, but also the possibilities of danger to passers-by from insects feeding upon the putrid contents of the carts.* With reference to the inspection of fish-markets and purveyors' shops, it may be said that it can hardly be too frequent, for not alone in themselves dangerous, the noxious germs of decaying organic matter are able to render impure numerous articles of food. In some instances trichiniasis has undoubtedly been prevented by such oversight. In a town in Middlesex County, the filthy cellar of a provision dealer whose shop was situated in the post-office building, where hundreds congregated daily, maintained through portions of every year the most intolerable stench, the foul flow therefrom entering a cesspit at the street corner close by, the odor of decomposing matter arising thence to sicken and annoy the community. A single day is too long a time to permit such wrong to be done. The practice of emptying the washing-tubs of sausage manufacturers and fish-mongers into the street gutters, is one that a heavy hand should be laid upon. The results of certain neglects of health in the fertilizing of soil with decaying animal matter have been referred to in a former report of the State Board.† It is believed that the attention of local boards may be profitably directed thereto.

In the execution in towns of these plans of garbage collection, it is well to secure, as a preliminary step, the coöperation and delegation of power of the selectmen and police authorities, for to them it will sometimes be necessary to look

* Charbon in Massachusetts: Second Report State Board of Health.

† Second Report State Board of Health, p. 142.

for support in securing to the party to whom the sole control of the collecting has been given (and only the sole control will pay) the full enjoyment of his right, numerous predatory collectors often endeavoring to divide with the owner his rightful spoils.

A regulation prohibiting other than the recognized scavenger from pursuing the business, should be created by the board, and will be sufficient basis for prosecution.

The removal of dead horses, dogs, cats or other animals from the public streets is properly the work of the health department, and should be provided for by contract with parties prepared therefor.

Slaughter-houses, Melting and Rendering Factories, etc.—These are agencies which, more extensive than their congeners, the provision shops and fish-markets, become, through their various processes, the most utterly disgusting and injurious of causes of wide-spread discomfort and disease.

One of the first and most irrefragible of a town's health regulations should be that prohibiting, absolutely, the establishment of any slaughter-house, abattoir, melting or rendering factory, bone-boiling, chemical or kindred works, without the especial permission and location of the board of health.

The history of the suburbs of Boston and other large cities, and of those cities themselves, abounds with cases of intolerable nuisances, destructive of comfort, pleasure, health and property, and the lesson thereof must not be suffered to go unheeded. Pine Island, in Boston harbor, Spectacle Island, in even earlier days, the chemical works of sundry places, the Brighton slaughter-houses, and the recent case of J. P. Squire's slaughtering establishment, all attest how baneful to all the best interests of a community these agents may become, when once introduced into a town. Not that their work is to be decried or abolished; on the contrary, by their processes of preventing waste and utilizing refuse, they may rightfully claim the appreciative approval of thinking men, *when* those processes are conducted under such scientific safeguards for the public health and weal as it has been shown that a rightful expenditure and sufficient knowledge can pro-

vide. The work of a board of health is not to drive off and discountenance the correct and advanced methods which these different employments have been made to take on, but to see that only such are employed. For not a few of the well-nigh indispensable commodities of domestic life and manufactures,—as soap, stearine, tallow, oil, glue, gelatine, etc., etc.,—we are indebted to these processes, and the grand principle of refuse utilization which runs through them all has need of every possible aid. By the Act of the legislature of 1871, not only was power conferred upon the State Board of Health to *close* offensive establishments in towns of four thousand inhabitants, but by the first section thereof, local boards were authorized to license, prevent the extension of, and to control and regulate such. The custody of such establishments, however, is by the law placed more especially in the hands of selectmen than of boards of health. Health officers have need, by study and observation, to familiarize themselves with the systems of the abattoirs established in foreign and our Western cities, at New York City, and at Brighton, in this State. It is believed that some of the processes, at least, which are here conducted, could be profitably carried out on a smaller scale in the establishments of country towns. A previous report of the State Board has too well reviewed the abattoir system in detail to make further mention here desirable.

The carcasses of dead animals, and the animal refuse found at these places, are possible sources of much virulent poison, and all collecting carts for such establishments should be compelled by regulation to have their contents safely covered from flies,* and the action of the sun. The conveyance of blood from slaughter-houses to sugar refineries, albumen makers and others should be permitted only in tight carts or barrels well covered. The disposal of offal from rendering-houses in the manner before specified, creating injury to water sources, cannot of course be neglected.

The Keeping of Hogs, Goats, etc.—While the keeping of these animals at slaughter-houses, and their subsistence

* Charbon: Second Report State Board of Health, p. 85.

upon the offal thereof, must receive absolute condemnation, their presence in thickly settled sections is but little less objectionable. If allowed at all within the limits of dense population, it should be only with every precaution and appliance against the discomforts that inhere to their habitations. Hogpens should be kept dry by the frequent addition of earth, and cleanliness in feeding should be strictly observed. Many a tired citizen, in the sultry nights of summer, has been deprived of his needed rest by the sickening smell of his neighbor's pigpen, and has bettered his condition but little when forced thereby to close his windows. Goats, while less objectionable, from their noise, filth and odor, cannot be considered fit for co-occupancy with man. It is a conviction held, gained by some disagreeable experience, that neither hogs nor goats should be allowed within the closely peopled sections of a town, except by a special permit of the health officers for each case, and the right to revoke this permission at pleasure should be understood as in all cases reserved. For less inhabited sections or towns, it is probably enough that dryness and cleanliness of pens be required.

The most favorable hours for inspection of localities likely to be from neglect disturbed by the odors of pigpens, stables, privies, drains, etc., are those of night, especially if the air be warm as well as humid. The writer has found it of advantage, in the discharge of health duties, to visit frequently, late at night, various portions of the town, and to examine carefully into the location and causes of odors then readily observed, unopposed by those whose interest it was to conceal them.

Diseased Animals, etc.—The possibilities of the transmission of disease from animals to man, and then of the same from man to his fellows, as well as the effect of disease upon animals or their products as food, render of no minor importance the prevention of the presence of diseased animals within a town, and the sale or use of their flesh or products for subsistence.

An active health officer will not only be on the alert for the infraction of local law in this respect, but will also be

watchful for early indications of contagious or epidemic trouble with horses or neat-stock in his province. The all-important matter of the proper transportation, housing, feeding and dressing of stock intended for market is hardly less the concern of the health official, in his regard for the benefit of mankind, than that of certain organizations whose sole care is the brute creation.

The condition of private stables, as regards overcrowding, ventilation, etc., and those of milk-marketmen in particular, will not properly fail of receiving a share of the thought and attention of efficient sanitary officers.

The several epidemic and contagious diseases which have from time to time had extensive sweep over this and other States, while they have not been so productive of special knowledge of their causes, etc., as could be wished, have nevertheless furnished valuable information upon which to base observation and action in the future, and their history is well worthy the study of sanitarians. No efforts should be spared to improve the present plans for the transportation of cattle, swine, sheep and calves, which, as the Secretary of the State Board characterizes them, *are*, in the main, "barbarous and infernal."

Intra-mural Burying-grounds, etc.—The location of burying-grounds within the immediate limits of populous towns is a matter much more considered with respect to its effect upon health nowadays than formerly, but the numerous reasons that exist for fears that they may be, and certainly are, sources of ill-conditions of health, from their various influences, cause them to be reckoned with agencies requiring, at least, the regulation of boards of health. It is not too much to assert that the regulations affecting interments, and the location of all new burying-places, should originate with local health authority. Such authority will properly be familiar with the character of the soil occupied, its dangers of influence upon air or water, and the probabilities of future encroachments of population upon the adjacent or occupied territory, all of which will have a governing effect.

The interment of persons dying from virulent contagious disease, as small-pox, under proper care, may be made in the

public cemetery of a town, but there should be special precautions that none of the attendant acts of such burial should be of a character, or at such a time, as to permit possibility of contagion to subsequent visitors. Cases must be rare where the interment of a person having died of small-pox, and properly prepared for burial, has, after inhumation, been the cause of contagion.

The use of tombs can find no approval in sanitary law. As the advisors as well as executors of the health concerns of a town, boards should exercise every influence against the occupation by dwellings of land long used for cemetery purposes, or the burial of sewage, offal, or dead animals in quantity.

Clothing, Occupations, etc.—It is not uncommon for medical men to have their attention called to various evidences of disease in patients who visit them, which are plainly referrible to the special injurious influence of some of their articles of wearing apparel, or the occupations in which they are engaged, Fortunately, owing to the efforts of sanitarians, and such philanthropists as Reade, many of the baneful influences or processes of manufacture have dropped out of sight.

Patients have not infrequently applied to the writer for treatment who were suffering from skin affections, caused, beyond doubt, by the coloring or finishing matters of the clothing they had worn, purchased at the public shops.

A most valuable part of the work of a board of health is the careful observation of such irregularities of manufacture and sale, which permits a knowledge of this subtle and dangerous class of causes of disease. The admirable article upon "Poisonous Wall Papers," * in the third report of the State Board, conveys forcible suggestions concerning these baleful influences upon our homes, and also opens the eyes to the fatal effects and gross evils of the manufacture and use of arsenic-laden fabrics.

Though these and similar disturbances of public health may be for the present matters for observation, enlighten-

* Third Report of State Board of Health, p. 18.

ment and warning, rather than subjects of legal control, the data acquired by boards of health will not improbably furnish grounds for future enactments.

The manufacture of matches, snuff, and cigars, the packing of crockery, the working of rattan, the grinding of steel, the setting of type, and scores of other occupations known to possess causes of certain forms of ill-health, may find, it is hoped, through the careful observation of scientific health authorities, methods of lessening or destroying their injurious tendencies.

During the past two years certain observations undertaken in a large manufactory have established beyond doubt the cause of quick disturbances of health which have invariably appeared in all new operatives of a certain department. This cause, as determined by a careful record of weight, diet, etc., was found to be the nervous activity required in the rapid manipulations of the work, in which the digits must make hundreds of movements per minute. A continuance of oversight has shown conclusively that just in proportion as these rapid movements became purely mechanical and involuntary, the condition of health again arose to the average, and hence the disturbances which were at first attributed to other and fouler causes, are shown to have not only a direct, but a self-regulating origin. Similar examinations are commended to health officers everywhere.

Tenements, Schools, Public Buildings, etc.—The strong words of so honest and able a man as Mr. Rawlinson,* are of themselves sufficient to direct the attention of health officers, and sanitary and social scientists, everywhere, to the conditions of our prevalent tenement system. He says, "Defective house accommodations produce disease, immorality, pauperism and crime, from generation to generation, until vice has become a second nature, and morality, virtue, truth and honesty are to human beings thus debased, mere names." The evidences of the truth of this assertion are on every hand, and demand the earnest coöperation of Christian workers in every field for their modification.

* Report State Board of Health, 1871, p. 193.

The low, overcrowded, filthy tenements of our manufacturing towns, are the sources of an overwhelming proportion of the work of health officers; and whatever aims at their improvement is not alone an addition to the chances of public health, but to wealth and morals also. No single object of the efforts of sanitary control requires greater study or labor, and it is earnestly hoped that health officials will address themselves to it with vigor. While in reference to public buildings, the relationship of a board of health is advisory only, it cannot too greatly magnify its office in this behalf, and should steadfastly urge upon those in immediate charge of the construction and care of school-houses, public halls, etc., the vital importance of correct and sufficient ventilation.

If, as is now prominently asserted, "one of the most prolific sources of consumption is rebreathed air," what hot-beds of this disease many of the schools of our children, our places of worship, and our public assemblies must be! In an active town in this State, a generous citizen thereof, but a few years since, made to the municipality the magnificent gift of a costly and stately town-house. It had not long been in use before it was discovered that no provision whatever had been made for the ventilation of the building, save by the doors and windows. At the large public gatherings, held in the main auditorium, especially at the crowded course of free scientific lectures, which the same liberality provided, it was the frequent event to have numerous cases of fainting in an evening, and more than one severe cold and pneumonia has followed an attempt to escape, at an open window, the effects of the heat and suffocation. In self-defence, the town has been obliged to ventilate the building at considerable expense.

Food, Drugs, etc. Their Adulterations, Impurities, etc.—One of the most difficult duties that devolve upon a local board of health, is the proper inspection of the various channels of supply of the food, drugs, etc., consumed by a community, and the exercise of proper precaution in regard to the several articles used, to insure their freedom from adulteration, impurities, etc.

The duty, as has been said, is difficult, but is imperatively necessary of performance, if the public health is to receive

that care and guardianship its importance demands. One cannot read any of the more recent publications of our own or foreign authors * on this subject, and avoid the conviction, that without some adequate provision in law for the prevention of the frightful impositions and dangers involved in modern adulteration of articles of the commonest use, life is placed in constant and imminent peril.

The requirements of knowledge for a successful conduct of this branch of board duty, will sufficiently attest the need of the best men and physicians for board of health work. The exact bearing of the whole subject of the adulteration and sale of food, etc., to the custodians of health and morality is so well stated by Hassall, in his work entitled "Adulterations Detected in Food and Medicine," that the reader is referred thereto with confidence. While it does not lie within the scope of this article to examine minutely into the extent, origin or results of the extensive adulterations and impurities known to exist in so many of the staples of every-day use, it is desired to lay before all in any way interested in the preservation of public and individual health, the evidences of necessity for careful, but firm exercise of authority in this department. When it is shown by repeated and competent examinations and analyses, that the following articles are daily sold for domestic use in the conditions annexed, and that these are only a few of the many so offered for sale, it will be readily admitted that there is need of *some* exercise of oversight and control.

It has come under the writer's own observation to find exposed for sale, the following :—

Meat. Of various kinds, impure and tainted, unfit for use and liable to produce the most disagreeable and dangerous results.

Pork. In which *trichinæ* were discovered.

Veal. Killed when only a few days old.

Fish. Tainted and foul.

Oysters, clams and lobsters. Stale and decaying.

Sausages. Made from impure meat and seasoned with adulterated spices.

Milk. Adulterated with water, flour, chalk, salt, sheep's brains, gum-arabic annato and caramel.

Bread. Mixed with alum, lime-water and lead (the last ground in the flour).

* The Adulteration of Milk. Adulteration and Impurities of Food. Hassall's Adulterations Detected.

Flour. Adulterated with ground damaged peas, alum and kaolin, and containing numerous impurities, as worms, insects, *acari* and "smut."

Cake. Flavored with oil of almonds containing a large per cent. of prussic acid.

Coffee. Adulterated with chickory, beans, peas and corn.

Tea. Colored with black-lead and prussian-blue.

Spices, etc. Variously adulterated. Cream of tarter with chalks. Ginger with five different substances, turmeric being the worst (except that Cayenne added in one sample was possibly itself adulterated with red lead). Black pepper by buckwheat cannel or "shorts," Cayenne as above, and arrow-root, with the most inferior damaged flour.

Cheese. Colored with saffron, Venetian red, carrots and annato, this last harmless enough if not containing the poisonous chromates.

Butter. Mixed with fat and lard and loaded with salt.

Essences. Variously adulterated and contaminated by nitro-benzole, prussic acid, oil of turpentine, and sulphuric and citric acid, etc.

Confectionery. Adulterated with, and poisoned by, arsenic, sulphate of copper, prussic acid, tartaric acid, and fusel oil.

Pickles. Injured by the use of sulphate of copper in preparation.

Sugar. Adulterated by several additions, as clay, sand and bean-dust and injured by being purified with putrid blood.*

It would be easy to continue the list even further, special interest having been taken in this department the last year. It is ample however, to show the pressing and vital need of efficient legal regulation and control.

It is due to the larger proportion of our dealers in these various articles to say, that they are unaware of the character of the goods they sell; but there can be no similar excuse for the manufacturer nor for the dealer, when the evidence of the senses is sufficient, as in tainted meat, "mitey" cheese, rotten vegetables, etc., to attest their unfitness for food.

It is evident that if lack of knowledge is a continuing cause of so grave evils, a duty of imparting instruction rests somewhere, and the recommendation of the Chairman of the State Board of Health † in his address at the inauguration of that body, should be carried fully into effect at an early day. It is also evident that the plea of ignorance on the part of dealers is unworthy of acceptance, if there is manifest either a disposition on their part, to prevent inquiry into the character of their wares, or to neglect the recommendation of health authority in relation thereto. Fortunately the powers of boards of health and public inspectors as created by

* First Report State Board of Health, p. 23.

† First Report State Board of Health, p. 12, (a), (b).

statute,* are sufficient for the search for, seizure, inspection, destruction and disposal of, such injurious compounds or articles as may be legally declared suspicioned, and punishment for possession, manufacture or sale is provided for, though not to the extent that could be desired. As certain Acts require to be adopted by towns before being operative, officers of health should charge themselves with the duty of seeing that the requisite action is taken to make this power of law available. The most important of these Acts is that approved April 20, 1872. It has been found that the publication of the name of guilty sellers or holders of certain articles, has been by far the most efficient of the checks provided. The wise use of this lever is urgently recommended to boards.

The inadequacies of the law in this behalf, and valuable recommendations in reference thereto, are to be found in the last report of the State Board † in a special connection.

It cannot be doubted that a fast advancing public opinion will, erelong, fully recognize the importance of health over and above any squeamish objections to fancied disregard of "personal liberty" and property rights, involved in the control of dangerous commodities.

If a mad-dog and nitro-glycerine are dangerous, even though rarely present, agencies, and as such are unquestionably to be taken care of, how much more needfully and constantly so, the food of our infants and invalids, the substances on which our existence depends!

The numerous cases of ice-cream and confectionery poisoning recorded of late, the instances of sickness resultant on soda-drinking, the injurious action of drugs contrary to their normal course, the frequent complaints of bread, meat, fish, vegetables and milk, to say nothing of groceries, etc., all indicate to the intelligent and active health officer the avenues into which his watchfulness should be turned. Where wrong is discovered and pointed out, but persisted in, it becomes a grave and imperative duty to proceed against the offender, without fear or favor.

Prosecution inevitably produces agitation, and agitation

* Gen. Stats., chaps. 49 and 166.

† Fourth Report State Board of Health, p. 303.

will diffuse intelligence that cannot fail of placing the condemnation of the public upon the perpetrator of wrong and final approval upon the prosecutor. Particular attention may well be given to the manufacture and sale of children's painted toys, of which particular mention has been made in a previous State Board Report.* Such possible agencies of the worst results demand insight and regulation.

VACCINATION.—This great and invaluable aid in the prevention of special disease has its claim as such too well recognized and proven to require any argument here. Foremost in the lists of both preventives and restrictors of a chief disease, disturbing all communities, vaccination is a means of protection that the health officer can never disregard. Its application has been made, by law, *almost* universal; and the enforcement of the law is alike the duty and the necessity of every health board. A general oversight of a community should be maintained in this regard, and families moving into a town, especially if immigrants from abroad, new operatives at factories, children at public schools, and almshouse or jail inmates, should receive special attention. The police of a town should be instructed to be observant at *dépôts*, etc., of incoming parties or luggage liable to suspicion, and, if such are discovered, to report the same at once to the health authority. The following regulations are believed to cover the ground, and are based closely upon the relevant law:—

REG. 1.—Every child must be vaccinated before *two years* of age. The board earnestly recommend that all children be vaccinated before *six months* of age, and that all persons be revaccinated as often as once in five years.

REG. 2.—All persons above two years of age who have never been vaccinated must be vaccinated immediately.

REG. 3.—All incorporated manufacturing companies in this town shall cause each new employé to be vaccinated on entrance, unless proof is furnished of successful vaccination within five years.

REG. 4.—The provisions of the 3d Regulation shall also apply to the keeper of the almshouse and jail in reference to each new permanent occupant.

REG. 5.—No person, teacher or scholar, shall become a member of any public school until vaccinated, unless furnishing to the school committee the certificate of a regular physician of this town that he or she has been successfully vaccinated within five years.

REG. 6.—The school committee are required to demand such certificates before granting permits to scholars or appointments to teachers.

* Third Report State Board of Health, p. 28.

Vaccination should be, in every sense, made compulsory; and the protection of the community from so dreadful a disease as small-pox requires something more than the imposition of the trifling fine of *five dollars*, once a year, for refusal to comply with the sections of law requiring it. It is to be hoped that early legislation will establish a more efficient and equitable control in this regard, as well as provide for vaccination at an earlier age than *two years*. It would be well for a board, in time of prevalence of small-pox, to secure, for the use of those to be vaccinated at public expense, a regular avenue of supply, and have kept for general advantage a record of public vaccinations with data.

[Chapter 3.]

The Restriction of Disease.—The work of a local board of health, involved under this second general head, is neither small in amount nor minor in importance. While it is true that by prevention the agencies of restriction are less frequently required, perfect immunity from disease liable to extend itself cannot be expected, and its occurrence is the signal for the active employment of every method possible for restricting its effects to its primary seat and individual.

Of course by far the greater per cent. of disease occurring in northern latitudes, requiring the control of health authorities, is small-pox, and the measures affecting it must be stringent and speedy of application. The following regulations are believed to approximate to what should be embodied in orders for the purpose:—

Reg. 1.—Any householder, in whose dwelling there shall break out a case of cholera, yellow fever, or small-pox, shall immediately notify the board of health of the same, and, until instructions from the board, shall not permit any clothing, or other property that may have been exposed to infection, to be removed from the house, nor shall any occupant take up residence elsewhere without the consent of the board.

Reg. 2.—Any physician who may be called to a case of either of the diseases specified in the foregoing regulations, shall at once report such case to the board, and receive their instructions in regard thereto; and whenever there shall come under the observation of any physician such number of cases of scarlet fever, measles, typhoid fever, dysentery, or "spotted fever," so called, as in his opinion to justify the belief that a considerable epidemic thereof exists, he shall at once report the same to the board, with such suggestions in regard thereto as may seem to him expedient.

Reg. 3.—No person sick with any of the diseases specified in Reg. 1, shall be removed at any time except by permission and under direction of the board of health.

Reg. 4.—Persons affected with either of the diseases specified in Reg. 1, and all articles infected by the same, must be immediately separated from all persons liable to contract or communicate the disease, and none but nurses and physicians will be allowed access to persons sick with these diseases.

Reg. 5.—All vessels used by such patients must be emptied immediately after use, and cleansed with boiling water.

Reg. 6.—Persons must not leave the premises until they, together with their clothing, etc., shall have been disinfected, and permission given by the board of health.

Reg. 7.—All bedding and personal clothing affected with contagion or infection, which can without injury, must be washed in boiling water.

Reg. 8.—Infected feather-beds, pillows and hair-mattresses must have their contents taken out and thoroughly fumigated, and their ticks washed in boiling water. Infected straw and excelsior mattresses must have their contents removed and buried, and their ticks washed in boiling water. Infected blankets, sheets and pillow-cases, and all articles in contact with or used by the patient, must be washed in boiling water.

Reg. 9.—Personal clothing and bedding, particularly comforters, which cannot be wet without injury, must be disinfected by baking or by fumigation, but no article must be burned without the direction of the board of health, and all disinfection and fumigation not specified in Regs. 7, 8 and 9, must be done by or under the direction of the board.

Reg. 10.—No person or article liable to propagate a dangerous disease, shall be brought within the limits of this town without the special consent and direction of the board; and whenever it shall appear to any person that such person or article has been brought into the town, immediate notice thereof shall be given to the board, and, if such person or article remains within the town, the location thereof.

In cases of small-pox, the vaccination of *all* exposed persons should immediately follow the discovery thereof. In this, and *isolation* of those infected, is the safety of the public alone to be found, *and without these*, *all other care*, *disinfection or warnings will be futile.* A board of health should early determine what course it will take with reference to cases of small-pox that may appear in their town, and with ample power vested in them by law, whether they will, if not possessing hospital accommodation for contagious diseases, seize and fit properly for such use, or will make quarantined premises of those occupied by the patient when seized with the disease. It is also requisite that the board shall determine who shall be admitted to infected premises, under what restrictions, and how they shall be disinfected. On many accounts, it is believed best for the board to have its own physician or physicians, who alone shall enter quarantined

premises; on others it is better that the regular physician of the patient, if there be such, shou'd attend, under such regulations as will hardly fail to suggest themselves. The weight of argument is believed to be, however, strongly in favor of only as few physicians as possible exposing themselves and others to the possibilities of infection, and these should neglect no safeguards against the spread of the disease.

On the discovery in a town of a case of small-pox, the following routine of action is believed to be substantially that indicated for a board of health:—

1. The case having been surely made out, or if in doubt, the danger-flags should be at once conspicuously displayed upon the premises, and the approaches thereto, and all intercommunication with the outside world be forbidden, except such as permitted by the board. It must be definitely understood that no *person* or *article* can be suffered to go from the premises and none to come upon, except to remain, and this only by the consent of the board.

2. All persons with whom the patient has recently been brought in contact, whether at home, at work or elsewhere in the town, should be immediately vaccinated. (It will be for the attending physician to determine whether he will vaccinate the patient, and how he will treat him.)

3. The patient (if it be not already done) should be immediately confined to one room, which should be as clean, large and airy, but as *secluded*, as possible, without carpet, and free from all superfluous furniture, clothing, etc.

This, of course, in case the individual is to remain at his home; otherwise, his removal to hospital will immediately follow the discovery of the disease, and he would there be under the regulations made and provided by the board and their physician in charge.

4. Arrangements should at once be made for the supply of necessities for the patient (to include nurse if necessary) and those quarantined. Purveyors should be instructed to leave their goods at a certain distance, or in such manner as may be prescribed by the board, or to deliver them through the physician or agent of the board.

5. Free use should be made of disinfectants about the prem-

ises, especially in passages leading to the room of the patient. The writer has found nothing better than carbolic acid.

6. Regular visits to the premises should be arranged for the physician and the representative of the board.

7. The police and fire department should be notified of the quarantine; the police, that they may aid in making the isolation effectual, and be at hand to attend to contingencies or emergencies arising therefrom, and also to guard against possible incendiarism; the fire department, that any attempts to burn the buildings might be the more promptly provided for, and in case of fire in the vicinity, the premises be less freely entered. Remarkable circumstances occurring in the history of a board of health in this section, not long since, render these precautions worthy of consideration.

Having thus provided for the care of the patient and those isolated with him, and for the prevention of intercourse between the premises and the community at large, it becomes necessary to maintain, until all danger from this source is over, a rigid and thorough seclusion of all pertaining to the infected habitation.

This segregation of individuals (often quite a number), most of them in good health and able to labor, the interruption of their revenues, but the increase of their expenses, involves many questions of responsibility and legality, that must rest upon the shoulders of the board of health, and that, unless met with prudence and knowledge, may entail litigation and expense upon a town that may so disturb it as to create a distaste for all matters of sanitary control in the future (so capricious is mankind), and a neglect of health interests be long the result. The law has fortunately explicitly determined where the expense of care, etc., shall lie, under varying circumstances. It is beyond question, that an action against a town or other party to recover for wages lost during confinement for weeks in a small-pox habitation, though not ill, would not lie. The question of where the responsibility shall rest for expense if a party so confined is a non-resident and has settlement elsewhere, is one that each case must de ermine of itself. It is specially enjoined upon boards that, in the interest of common honesty and the continuance of such agencies of control, they manage the business devolving upon them with the

wise economy that belongs to individual affairs (but always leaning to the side of safety), and show as a part of sanitary science, that it is in fact not expensive, but economical and productive. That quarantine should be effectual, it must last long enough to allow time for each individual upon the premises to have contracted the disease from even the last day of the patient's desquamation,—*i. e.*, supposing the case to have been an ordinary one, and the particles of falling skin being apparently all gone from the patient by the end of his fourth week of sickness, the inmates of a dwelling should then remain isolated for two weeks thereafter, and be kept meanwhile from all contaminated clothing or bedding, unless the same shall have been as thoroughly purified as possible. Of course, if subsequent cases break out in the dwelling, the initial point of reckoning is transferred from the first patient to the last. In case the patient is removed from his home to a hospital, the remaining inmates will only require to be quarantined till it is reasonably sure that they have not been infected (generally about two weeks), and the same caution will be required as before mentioned for all contagioned articles. That so rigorous and careful a quarantine as is thus provided for has not been generally enforced, the extent of last year's epidemic of small-pox too well attested.

Upon the dissolving of quarantine, certificates should be given to school children, factory employés and others, of their non-liability to communicate disease, and, of course, the danger-signals and prohibition of intercourse will be removed. No patient who has been sick with any contagious disease, recognized as such by statute, should be allowed to leave his room until duly bathed, disinfected and freshly clothed, nor until all infected articles about him have been purified to the satisfaction of the health authorities.

Boards of health will not fail to notice that the powers given them by law, to collect expenses of patients under their care from other towns or the Commonwealth, are in excess of those granted overseers of the poor, and their care of patients is, and should be, entirely independent of such authority. The surprise of the writer may be imagined, when informed by the auditor of the Commonwealth, on presenting a bill of his board for the care of a State patient, that, although it was

evident that the law provided for such payment, and had been upon the statute-book for many years, no prior claim of the kind had, to his knowledge, been made, and certainly no appropriation had ever been made therefor. It would be interesting to know how many town taxes have been invalidated in the past, and how many tax titles are hence insecure, by reason of towns having paid from their treasuries, without authority, the expenses that should have been otherwise borne.

The safeguards that apply to small-pox are also, in the main, applicable to the other contagious diseases, recognized by the law as such.

In reference to typhoid fever, cholera, etc., it is essential for its restriction, that the fœcal discharge of patients shall not be allowed to disseminate their powers of increase through air, water or food, and regulations to that intent should be established.

The regulation of *prostitution*, being an offence against morality, has long been under the control of police authority, but it is believed that the conditions that attach thereto have so intimate and vital a relationship to the health of communities, that at least a union of surveillance will erelong be fully recognized as desirable. As an advisory board, health organizations can, under present circumstances, contribute much toward the best control of this potent influence for disease.

The various influences inimical to public health, which reside in bathing-rooms, barbers' shops, public conveyances, etc., are all matters subject to the controlling regulations and oversight of local boards of health, and should receive their attention,

[Chapter 4.]

General Observation.—Under this last caption, it is desired simply to call the attention of boards to the work of general scientific and protective oversight it lies within their province and opportunities to undertake.

It is believed that where there are lakes or streams contiguous to towns, it is well for boards to have prepared and conspicuously posted, directions for the resuscitation of drowned persons, after Hall's or Sylvester's methods.

Boards should also have a general review of—

The removal of remains from cemeteries.

The character of the water-supply.

The drainage of territory.

The laying out of pleasure-parks.

The regulation of gas and mechanical works liable to affect by their smoke, or processes of manufacture, the health of the locality.

The location of buildings, with regard to their supply of light and air.

The condition of lock-ups, jails and almshouses.

The laying of sewers and water-mains.

The condition of public urinals, etc., etc.

They should also carefully observe the mortality records of their town, and the climatic and other general or special influences affecting it, and should contribute by publication to the fund of general sanitary knowledge, any experiences or observations of value. A well-kept meteorological record is both a credit and an aid to any board.

It will not infrequently be well for boards to establish special inquiries and investigations into the character of their peculiar geological, meteorological, or geographical relationships, or into kindred subjects affecting inferentially their public weal.

Public lectures upon hygiene, by parties able to plainly and practically lay before the people the laws and requirements of public and private health, are agencies for good, that every board would do well to inaugurate.

Such are the fields, and such the divisions of labor and observation, that boards of health, wherever situated, are called upon to enter. The sum total of labor performed in a year by a conscientious health officer is very great, and in its accomplishment he must expect to find his chief reward, recognizing the force and beauty of the motto of Haroun-al-Raschid, that "He only worships God acceptably who makes himself useful to his creatures."

ON THE

Use of Zinced or Galvanized Iron

FOR THE

STORAGE AND CONVEYANCE OF DRINKING-WATER.

BY W. E. BOARDMAN, M.D., OF BOSTON.

USE OF ZINCED OR GALVANIZED IRON.

The Report of the State Board of Health of Massachusetts, for the year 1871, contains a paper upon "Poisoning by Lead-Pipe," which is confirmatory of the now well-recognized fact, as illustrated in the following paragraph (p. 40):—"From the evidence presented in the preceding pages, it seems reasonable to believe that the use of lead-pipe for the conveyance of drinking-water is always attended with a certain degree of danger, because such water always contains lead; and that this danger varies in degree with the character of the water conveyed and the susceptibility to lead poison of those who drink it."

With the view of obviating the dangers arising from the use of lead-pipe, different methods and materials have been suggested from time to time. In this way, zinced (or what is termed commonly galvanized) iron has come into use, and at the present time is extensively employed, both in this country and in Europe, for the purpose of roofing material, gutters and conductors, reservoirs, water-conduits, bathing-tubs, cooking utensils, etc.

The object of the present paper is to determine, if possible, whether or not the employment of this material for the storage and conduction of drinking-water is attended with danger of zinc poisoning, as has been re-affirmed recently.*

The various modes of protecting iron, *with the exception of mere superficial coverings*, have all been of the electro-chemical class, and have been derived, in various ways, from suggestions deduced from the experiments and observations of Sir Humphry Davy,† for the protection of the copper sheathing

* Boston Journal of Chemistry, Vol. V., 1871, *passim*.

† Phil. Trans., Vol. CXIV., 1824, and Phil. Mag., 1st Ser. Vols. LXIV. and LXV.

of vessels. In his paper on this subject, the author developed the principle of counteracting chemical by electrical forces. Subsequently his idea was adapted to particular cases. He stated that it follows from the principles which he developed, that cast or wrought iron may be preserved from chemical action by suitable protectors of zinc or tin. Prof. Edmund Davy was the first to publish * a series of experiments which he undertook with the view of determining this protective power of zinc, which he employed in simple contact and in massive form. Shortly after the publication of the results of these experiments by Prof. Davy, M. Sorel, a French engineer, obtained a patent for the protection of iron against rust by coating its surface with fluid zinc, and, with this patent, the first manufactories of zinced or galvanized iron were established in London, under the style of the "British Galvanization of Metals Company," and the "Zinced or Galvanized Iron Company." Prof. E. Davy, however, claiming priority of discovery, stated that he had employed this method of zincing iron so far back as 1834, yet we have no other record of such experience than his simple statement. Without knowledge of the principle, however, Madame Leroi de Jancourt was granted a patent on the 26th of September, 1791, for preserving metals from rust by covering them with an alloy of zinc, bismuth and tin.

Zinced or galvanized iron is prepared by dipping the iron, previously well cleaned by means of dilute acid, into melted zinc. By this process, the iron becomes superficially combined with the zinc, and there is furnished, as claimed by the first manufacturers, a material which is adapted for use as water-pipes, reservoirs, etc., is durable, cheap, and is unattended with danger to the human system in the way that lead is when employed for similar purposes.

In order to discuss connectedly and to the best advantage the subject which we have in view, it has been deemed advisable to consider it under the following heads, viz. :—

1. Is the zinc of galvanized iron acted upon by water, and what are the products of such action?

* Report of the British Association for 1835.

2. Do these products exert a poisonous action upon the human system?

1. The action of water upon zinc has been recognized for a long time. In the year 1778, M. de la Falie, a French physician and chemist, in place of vessels of iron, copper, etc., then employed for culinary purposes, proposed the use of iron vessels lined with zinc, principally upon three grounds; namely, because, in his opinion, the zinc would not be dangerous; such vessels would not be very expensive, and they would be more durable.* A subsequent report to the French Academy of Sciences disapproved of the use of these vessels, on the ground that the zinc is removed and endangers the health. Discoveries of new sources of supply of the metal and of the means of rendering it more useful in the arts, led to the revival of its employment, by MM. Douey and Montagnac, in the manufacture of culinary articles, roofing materials, reservoirs, water-conduits, etc. The first petitions of these gentlemen to the proper authorities having been reported upon unfavorably, by MM. Thenard and Gay-Lussac,† they made another petition which led to a series of experiments by MM. Vauquelin and Deyeux,‡ under the authority of the Academy of Sciences. In their report they state that zinc is acted upon by water, the weakest vegetable acids and butter; that water, allowed to stand in zinc vessels, was partly decomposed and a white oxide was produced, while the water covering the oxide had a metallic taste.

M. Schaufèle § made a series of careful experiments, the results of which were confirmed later by distinguished chemists, notably by Payen and Chevallier,|| with the view of determining the action of various substances upon zinc. He found that common water, allowed to stand in a galvanized iron vessel, presented traces, very slight indeed, of zinc at the expiration of thirteen hours; that common water, placed in pure zinc vessels, gave no indication of the presence of

* Annales de Chimie, t. 86, p. 51. 1813.
† Jour. de Méd. de Corvisart, t. 36, p. 225.
‡ Annales de Chimie, t. 86, p. 51. 1813.
§ Jour. de Chim. Méd., t. iv., p. 663, 1848, and Tardieu, Dict. d'Hyg. Publique, t. 3, p. 708. 1854.
|| Tardieu, loc. cit.

zinc; that distilled water showed traces of zinc, in five hours, both in pure zinc and galvanized iron vessels.

Similar results have been reported by numerous reliable observers. Prof. Wm. Ripley Nichols, of the Massachusetts Institute of Technology, remarked to the writer that he always expects to find zinc in water which passes through galvanized iron pipes, and, in a written communication, he stated that a specimen of water drawn from the pipes, which have been in use in the Institute for eight or nine years, contained a small amount of zinc in suspension, and in solution an amount equal to 0.062 grain to the gallon. The water had remained undisturbed in the pipes for about thirty-six hours.

Another specimen of water was examined by Prof. Nichols, at the request of the writer. It was spring-water which had passed through between forty and fifty feet of zinced pipe, from which no water was drawn previously for about twenty-four hours. The analysis gave rise to a suspicion of drainage contamination, and detected a trace of zinc in suspension and 0.843 grain to the gallon in solution.

This subject of the action of water on zinc has been most ably treated by Robert Mallet,* who drew up a series of papers showing the results of experiments made by himself, with the view of determining the best protector for iron against corrosion by air and water. Among the conclusions derived from his prolonged and carefully conducted experiments, the following may be quoted in proof of the affirmative of our question:—

"OF CAST-IRON IN SIMPLE CONTACT WITH ZINC, IMMERSED IN FRESH WATER.

"If cast-iron be perfectly free from any initial stains of rust and quite homogeneous in texture, it is electro-chemically preserved by an equal surface of pure zinc for an indefinite period, during which the zinc is oxidated, and forms mammillary concretions on the iron; after which the protective power of the zinc is greatly diminished, and, at this stage, the contact of any substance, even a neutral one,—such as glass,—with the iron, is sufficient to originate oxidation upon it.

"If cast-iron, having a polished surface, is suffered to contract any coating of rust, although the surface be afterwards perfectly polished to the eye, yet zinc, in simple contact, has lost nearly the whole of its power of protection; the zinc and iron both oxidate from the moment of immersion.

* Report of the British Association, Vols. VII. and IX., for 1838 and 1840.

"OF CAST-IRON, IN SIMPLE CONTACT WITH ZINC, IMMERSED AT AN INDEFINITELY SMALL DEPTH IN FRESH WATER.

"Cast-iron, free from initial rust, so exposed in contact with an equal surface of zinc, is oxidized from the first moment of exposure. The zinc is oxidized from the first, also.

"A plate of iron, whose entire surface was covered with zinc in metallic contact [zinced or galvanized iron], was immersed for twenty-five months in fresh water. On examination, much flocculent zinc had been formed, and lay at the bottom of the glass vessel, which, in some places, was stained with red oxide of iron. The zinc surface was found, in irregularly scattered patches, wholly removed down to the iron, which was covered with peroxide. Hence, about two years appears to be the limit of the preservative power of zinc to iron in fresh water, applied in fusion over its whole surface by the ordinary method. It is to be observed that the zinc surface was removed by solution, unequally or in patches, indicating local action *ab initio;* and it has been shown before that as soon as oxidation takes place at any point upon the iron surface, the protective power of the zinc is diminished at once or rendered null. [The corrosion of both zinc and iron then ensues more rapidly.]

"The conditions the most favorable possible for rapid oxidation of iron consist in its exposure to wet and dry or to air covered with an indefinitely thin film of water, constantly renewed; thus circumstanced, zinc has no protective power over iron in fresh water, and, on the whole, it may be affirmed that, under all circumstances, zinc has not yet been so applied to iron to rank as an electro-chemical protector towards it, in the strict sense."

In a report,* made by Prof. Max Pettenkofer, in reply to the inquiry, how thick a covering of zinc is required to insure permanent protection against the oxidation of iron, the author gives the results of a series of experiments, undertaken by himself, with zinc plate taken from the roof of a building in Munich, where it had been exposed to the atmospheric influences during twenty-seven years. The outer surface was found to be covered with a thick, whitish, oxidized layer, of varying depth, showing that the oxidation had followed the crystalline structure of the metal. By calculation, he determined approximatively, that upon a piece of the zinc, one and a half feet square, there were present 4.264 grammes of zinc rust. By experiment, also, he estimated the amount which had been removed during these twenty-seven years, in the rain-water, in solution and by mechanical displacement, as about 4.117 grammes, making a total of 8.381 grammes.

The preceding observations, which have been made at

* Abhandlungen des naturwissenschaftlich-technischen Commission in München, Vol. I., 1857.

different periods, and were derived from a variety of sources, will be sufficient to illustrate the fact that the zinc of galvanized iron is acted upon by water; that, when allowed to stand in reservoirs or to flow through pipes of this material, water will contain a greater or less amount of zinc, for a longer or shorter period; finally, that, sooner or later, the whole of the zinc will be removed.

With reference to the second part of our first inquiry, —namely, What are the actual products of this action of water upon the zinc?—the conclusions at which we shall be able to arrive will not be so definite. We know that various circumstances, conditions and processes combine to render water, in its ordinary state, a very complex fluid. Receiving its constituents from the air and ground, in various combinations, the laws of which are imperfectly understood, it contains mineral, vegetable and animal matter in suspension, and gaseous, organic and mineral matter in solution. The mode of combination of these various substances in solution cannot be determined, at least with the means at our command at the present day. It is a popular custom, however, for chemists to ascertain, by analysis, the amount of each constituent and then to calculate the probable chemical combinations which have taken place. Carrying out this latter idea, chemists have reported that they have detected the presence of various soluble salts of zinc in water which has been in contact with this metal; the sulphate and the chloride have been reported, principally, and, in some cases, the statement has been made that water has been found "strongly impregnated" with these salts. The real basis of these conclusions is founded upon isolated chemical experiments, made in the laboratory, like the following:—*

"Zinc is rapidly dissolved in a very dilute solution of common salt [chloride of sodium] in water, and may be found in the solution, or water, as the muriate [chloride] of zinc. This would be the action of the common salt in rain-water, and it is the source of the corrosion of zinc roofs."

"Galvanized iron, introduced into a solution of copperas [protosulphate of iron] in water, very dilute, acts thus: I soon found iron-rust rapidly falling on the galvanized pipe. In a short time *all* the iron was precipitated from the water, and fell in a coat of rust, while its place in the water was

* Extract from a report to the City Council of Lowell, Mass. 1842. From Appendix to "Lead Diseases," by L. Tanquerel des Planches, Lowell. 1848.

supplied by zinc. In other words, copperas, or green vitrol, was exchanged for white vitrol."

"Galvanized iron, in a mingled solution of salt and of copperas, such as is found in several wells in Lowell, is rapidly destroyed; the water becomes charged with salts of zinc."

Without entering upon the palpable sources of error in the above experiments, judging them from the published account which is given here, it may be stated that the direct inference implied,—that similar re-actions always take place between zinced iron pipes and water passing through them, and containing the above-mentioned constituents,—is unwarranted.

At the request of the writer, Professor Wm. Ripley Nichols presents the following communication with reference to the action of water upon zinced pipes, and the products of this action:—

MASS. INSTITUTE OF TECHNOLOGY, CHEMICAL LABORATORY,
BOSTON, Dec. 24, 1873.

MY DEAR SIR:—With regard to the action of water on zinc, it is well known that, when zinc is exposed to moist air, it quickly becomes covered with a film of oxide, which soon changes, under the influence of the carbonic acid of the air, into a basic carbonate. The oxide at first formed has been regarded as a *sub-oxide* (Zn_2O), but is now generally held to be the ordinary oxide of zinc (ZnO). That this coating subsequently changes to a basic carbonate, and that the white compound of zinc, which is often found in suspension in water which has been in contact with "galvanized" iron pipes, is a (hydrated) basic carbonate, seems to be sufficiently well established. That the compound is not perfectly definite in its composition, but contains sometimes more, sometimes less, carbonic acid, in proportion to the oxide of zinc, is also an accepted fact.

What, however, is the state in which the zinc exists *dissolved* in water, we do not know, and probably cannot know. Although it has been stated in some cases that a given water contained in solution so much *chloride of zinc*, or so much *sulphate*, such statements rest upon purely gratuitous assumptions.

We have good reason to believe that absolutely pure water would have no action on absolutely pure zinc; but ordinary water contains a quantity, more or less considerable, of different salts, such as chlorides, sulphates, carbonates, and in what form the small amount of zinc in solution exists, it would be impossible to say.

We know that zinc is attacked by a solution of chloride of sodium (common salt), and that a portion goes into solution, hydrogen being at the same time evolved. In the case of a strong solution of chloride of sodium, the amount of zinc that is taken up is so considerable, that it is not unnatural to suppose that a portion of the zinc exists as the double chloride of zinc and sodium; but as undissolved oxide of zinc is also a product of the re-action, and as the solution is found to be alkaline, it is probable that, at the same time, some compound of oxide of zinc and oxide of sodium (zincate of sodium?) is also formed.

In the case of a drinking-water, which is a dilute solution of a variety of salts, the case would be very different, and although we know of this action of chlorides on zinc, we also know that nitrates and sulphates and other salts likewise attack the metal and are capable also of dissolving its oxide; we know further, that the oxide and all the carbonates of zinc dissolve in water containing carbonic acid, so that we are unable to say whether the trace of zinc found in solution existed as chloride, nitrate or sulphate, or as a salt of some organic acid, as (acid?) carbonate, (or carbonate held in solution by carbonic acid), or whether a portion existed in each and all these different states.

I may, perhaps, make my meaning more clear by using an illustration. If we mix together very dilute solutions of chloride of calcium and of sulphate of magnesium, we obtain a mixture which is not distinguishable in appearance from the solutions from which it was produced. If we submit it to chemical examination, we find that it contains a sulphate (or sulphates) and a chloride (or chlorides); also, that it contains magnesium and calcium. Analysis does not, and cannot, show whether the solution contains chloride of calcium and sulphate of magnesium or chloride of magnesium and sulphate of calcium, or whether it contains some chloride and some sulphate of calcium and some chloride and some sulphate of magnesium. The latter view, in fact, has the greater probability; the proportions in which the distribution occurs taking place according to some law at present not understood. But according to the fashion, formerly universal, which even now prevails to a certain extent, the solution, if analyzed, would be said to contain so much sulphate of calcium and so much chloride of magnesium, and for this reason: If the solution be concentrated by evaporation, sulphate of calcium will crystallize out, and may be obtained nearly free from chloride of magnesium. This, however, does not prove the previous existence of all the calcium as sulphate, for the condition of things in the liquid is changed by concentration. It is a general law, that when solutions of two chemical substances are mixed, if such a re-arrangement of the acid and basic radicals is possible, as to form a compound, *insoluble* in the liquid employed, or a *gaseous* compound, such compound will be formed; but where no insoluble or gaseous compound is formed, we cannot judge of the change which takes place.

Therefore, I do not hesitate to say, that we do not, and cannot, know what compound of zinc is present in solution in the case of water which has passed through "galvanized" iron pipes.

Yours respectfully,

WM. RIPLEY NICHOLS.

DR. W. E. BOARDMAN.

Vauquelin and Deyeux,* Devaux and Dejaer,† Mallet,* Schaufèle,* Gaultier de Claubry,‡ Tardieu,§ Pettenkofer,* Brande and Taylor,|| Bouchardat and Fonssagrives,¶ W. R.

* Loc. cit.
† Procès-verbal de la Séance, publ. de la Soc., établie à Liége. 1813.
‡ Annales d'Hygiène et de Médicine légale, t. 42, p. 347. 1849.
§ Dict. d'Hygiène Publique, t. 3, p. 706. 1854.
|| Chemistry, Am. Ed. 1863.
¶ Journal de Chimie Médicale, t. 10, p. 594. 1864.

Nichols*, all state—indeed, it is a well-known fact—that zinc, when exposed to the action of common, potable water, acquires a coating of oxide, which is practically insoluble in water. This coating, subsequently, is acted upon by the carbonic acid, which comes into contact with it, and it results from this, that the layer is finally composed of oxide, carbonate and a combination of these two, regarded as oxyhydrocarbonate of zinc, by Pettenkofer.† By mechanical and galvanic action and solution, the removal of this layer is effected gradually, and the water then contains more or less of these compounds in suspension, while the remainder enters into solution.

This much, then, is all that can be stated positively, at present, with regard to the nature of the products in question.

In regard to the amount of zinc, in all forms, metallic or other, which may be present in the water, many influences come into consideration. The water may contain ingredients, abnormal in kind or quantity, which will act with unusual energy upon the zinc, or it may be of such purity as to have but a slight action upon the metal. Again, as shown by Mallet,‡ imperfect construction of the material—if the iron be not properly freed from initial rust or if the zinc be incompletely applied, will favor the corrosion of the zinc, for as soon as the iron is exposed, the destruction of the zinc goes on more rapidly. The texture of the zinc, too, whether fine or coarse, affects the results.† If impure zinc be employed, it will be more readily destroyed. The length of time during which pipes have been in use, also, is to be taken into consideration.

The action of potable waters of the purity of the Cochituate is comparatively feeble. We have seen that this water, drawn through pipes which have been in use for eight or nine years, contained only 0.062 grain of metallic zinc to the gallon, while some chemists have reported the presence of from two to six grains § in the gallon of other waters, and this latter

* See communication in this Report.

† Loc. cit.

‡ Pettenkofer, loc. cit.

§ Boston Med. and Surg. Jour., Jan., 1871, p. 13.

fact is freely admitted by the manufacturers. It is to be observed, however, that in these instances of the presence of such a large amount of zinc, it is always in the form of the carbonate, principally, and the water presents a turbid appearance, which would deter most persons from using it for drinking or in cooking. In the experiments of Schaufèle,* water allowed to stand in galvanized iron vessels for five days, contained only traces of the oxide of zinc.

2. We come now to the consideration of our second inquiry; namely, Do the products, resulting from the action of ordinary drinking-water upon the zinc of galvanized iron, exert a poisonous action upon the human system?

In this inquiry, it seems unnecessary to take into consideration such extraordinary idiosyncrasies as are shown, sometimes, in the inability of individuals to take iron in any form, even in small amounts, or to receive the perfume of a rose without causing asthma. It is not to be denied that a similar extreme susceptibility to some property of zinc, may be the occasion of analogous effects.

It is to be premised, also, that we are not to include in our conclusions, the results which may be due to water unfit for drinking purposes, and which may contain ingredients that would act energetically upon zinc, and contain an unusually large amount of the soluble compounds of this metal.

We have, then, to consider the effects of the oxide, the carbonate and the compounds which occur in solution.

The oxide of zinc, first prepared by Hellot, in 1735, has been employed extensively since his time, both as a medicine and in the arts. Most authorities assert that it is innocuous, while some entertain suspicions of, or attempt to prove its poisonous character.

J. Johnstone,† not including zinc among the mineral poisons, relates, from his own experience, that ten grains of the oxide, taken daily for more than three weeks, were innocuous in the case of a boy about fourteen years of age.

MM. Vauquelin and Deyeux,* on the ground that the oxide, resulting from the action of potable water, is not

* Loc. cit. † Med. Essays and Observations. 1795.

injurious, recommended the use of zinc in the manufacture of reservoirs and water-pipes. This opinion was confirmed by Devaux and Dejaer,* and, a few years later, Orfila,† expressed a similar conviction. MM. Merat and Lens,‡ after enumerating the various uses to which this oxide may be put, remark, "Some writers state that it sometimes gives rise to colic, a phenomenon which we have never observed." They refer, also, to authorities, cited by J. F. Gmelin,§ who ascribe to it an irritant action, "which we believe, is not a fact." Christison‖ makes no reference to any injurious results from the internal use of this oxide, except that he coincides with Orfila, in his estimation of the results obtained by MM. Vauquelin and Deyeux. He also remarks, "that it does not appear that workmen, who are exposed to the fumes of zinc, ever suffer materially." Heller¶ went so far as to state that this oxide might be given up altogether as a medicine, since, being insoluble, it passes through the intestinal canal as inert matter.

M. Blandet** reported cases of supposed poisoning by the fumes of the oxide of zinc. MM. Guerard†† and Levy‡‡ and others, denying the connection of cause and effect in these cases, coincide in the statement that analogous accidents do not ensue from the internal administration of this compound. M. Bouchut,§§ in an elaborate memoir to the French Academy of Sciences, gives an account of the action of oxide of zinc upon the human system. He says, in doses of one to six grammes daily it never occasioned any gastric disturbance; occasionally it gave rise to sleeplessness and restlessness at night. He gives, also, a critical analysis of the classical cases of supposed poisoning by the oxide, which were reported by Blandet in 1844, Bouvier, Landouzy and Maumene in 1850, and shows conclusively that the ill effects in these instances were due to other causes.

In a review of the last-mentioned paper, M. Chevallier‖‖

* Loc. cit.
† Toxicologie Générales. 1818.
‡ Dict. de Matière Médicale, t. 6. 1834.
§ Apparatus Medicamimum, Vol. I., p. 286. 1795.
‖ Treatise on Poisons, Am. Ed., p. 389. 1845.
¶ Archiv. f. physiol. Heilk. 1847.
** Bulletin de l'Académie. Feb. 17, 1844.
†† Annales d'Hygiène, t. 33, p. 462. 1845.
‡‡ Traité d'Hygiène, etc. 1850.
§§ Annales d'Hygiène, t. 47, p. 5. 1852.
‖‖ Annales d'Hygiène, t. 47, p. 55. 1852.

confirms the opinions of M. Bouchut, and concludes that the oxide of zinc is incapable of producing death, or even of causing any serious effects. He also calls attention to the observations by Michaëlis, of Tubingen,* who stated that he occasioned the death of dogs with daily doses of a few grains of the oxide, a result contrary to those obtained by MM. Flandin,† Orfila ‡ and Bouchut.‡ M. Bouchut repeated the experiments upon which Michaëlis founded his opinion, but with negative results.

Pereira § remarks that this oxide may be taken, in small doses, for a considerable period, without causing any obvious effects; in large doses it sometimes causes temporary giddiness and inebriation. By long-continued use, however, he says, it acts as a slow poison; in proof of which he cites a case ‖ where twenty grains were taken daily for about five months. Rapid recovery, however, ensued as soon as the administration of the drug was discontinued. He refers, also, to the cases mentioned above, which were confuted by M. Bouchut and others.

Tardieu ‡ states explicitly that zinc imparts no poisonous qualities to water,—a fact which has been proved by theory and confirmed by experience. He refers to facts cited by M. Boutigny,¶ who attributed poisonous qualities to water collected in zinc reservoirs, and remarks that they have not been confirmed and must be regarded as absolutely exceptional, and, without doubt, were due to some special accidental circumstances.

Oesterlen ** states that the action of this oxide, when taken internally, is very slight, even in large doses, and expresses his doubts as to the efficacy of the drug, so long accepted, in various diseases. When given to *patients* in large doses, or for a long period, he says, it may give rise to unpleasant symptoms; yet "patients in the Paris hospitals have recently taken one to two ounces daily, and Trousseau †† has given ten

* Archives Générales de Médicine, t. 30. 1852.

† Annales d'Hygiène, t. 47, p. 38. 1852.

‡ Loc. cit.

§ Elements of Mat. Med. and Therapeutics, Vol. I., p. 677. 1852.

‖ British and Foreign Med. Review. July, 1838.

¶ Annales d'Hygiène, t. 17, p. 281.

** Handbuch der Heilmittellehre, p. 165. 1856.

†† See also Report by M. Bouchut, loc. cit.

grains and more, daily, to young children, even without perceiving any deleterious effects."

Schlosberger,* Michaëlis † and others have detected the presence of the metal in several of the secretions of the body. Van Hasselt ‡ confirms these facts, and asserts that all compounds of zinc, when introduced into the stomach, are transformed immediately into albuminates, in which form they enter the circulation. He gives his assent to the occasional production of what he terms "zinc dyscrasia," referring to the above cases reported by Pereira. In regard to the cases reported by Blandet (see above), and similar ones by Becquerel, Elfes and Rust, however, he coincides with the more general view, that they were probably due to other causes, which conclusion, he remarks, is all the more probable from the fact that the symptoms disappeared so rapidly on the removal of the supposed cause. The same argument might, with reason, have been applied by himself to the cases which he cites from Pereira in proof of the actual occurrence of "zinc dyscrasia."

Dr. Herpin§ remarks, "The oxide of zinc is perfectly harmless, and may be administered even in doses of six grammes daily, which may be continued for any length of time."

Greenhow || mentions a case of what he terms "brass-founders' ague," which, he says, is occasioned by the fumes of deflagrating zinc. These fumes are zinc vaporized in a metallic state and changed into the oxide by contact with the air.¶ This case was similar to those reported by Blandet and others, to which we have already referred, the conclusions in all of which were shown to be erroneous.

Stille,** after citing several reported instances of the ill-effects of this oxide, remarks: "Yet effects of this kind cannot be of ordinary occurrence, for we find that Home†† sometimes gave as much as forty grains a day without injury; that Sieveking cured a case of epilepsy in which thirty-six grains

* Arch. f. physiol. Heilk. 1848.

† Loc. cit.

‡ Allgemeine Giftlehre, ubersetz aus dem Holländischen von Dr. J. B. Henkel, p. 322. 1862.

§ Du Prognostic et du Traitement de l'Epilepsie. 1852.

|| Medical Times and Gazette, Vol. I., p. 227. 1862.

¶ M. Levy, loc. cit.

** Therapeutics and Materia Medica, 2d Ed., Vol. II., p. 138. 1864.

†† Clinical Experiments, p. 220.

of the medicine were taken three times a day, without any unpleasant effect whatever." * He refers, also, to the opinions expressed by Dr. Herpin, and quoted above.

MM. Bouchardat and Fonssagrives,† also, have shown that the oxide which may be contained in drinking-water is innocuous.

Wood and Bache,‡ referring to reported cases of *zinc colic*,§ remark: "This statement, however, is, to say the least, very questionable."

Hirt || remarks that some workers in zinc are liable to the ordinary affections to which founders and metal-workers generally are exposed, but that specific effects of zinc (referring to the oxide) have never been proved; that the digestive organs are not affected in the least, a fact upon which he satisfied himself by very extensive observations and inquiries.

Dr. Winsor,¶ of Winchester, Massachusetts, in a recent report, states that it is neither plain, nor is it at all probable, that any person has been in any way poisoned by drinking-water which is impregnated with zinc, in the form of oxide or carbonate. In this opinion, he observes, he is confirmed by inquiry made of skilled analytical chemists, of experts in materia medica and toxicology, manufacturers of zinced pipes, house painters, and others.

The board of water commissioners of Melrose, Massachusetts, in 1871, issued an official circular to "Spot Pond Water Takers in Melrose," in which they urged the immediate removal, or the discontinuance of the use, of galvanized iron service-pipes. The immediate cause of this action on the part of the commissioners seems to have been the occurrence of some cases of sickness, one proving fatal, in the family of the chairman of the board.** The attending medical adviser of the family pronounced them to be cases of zinc poisoning, and J. R. Nichols & Co., of Boston, assent to this opinion, having made an analysis of this water drawn

* On Epilepsy, p. 274.
† Loc. cit.
‡ United States Dispensatory, 12th Ed. 1865.
§ Chemical Gazette, Sept. 16, 1850.
|| Die Staubinhalations-Krankheiten, p. 99, Breslau. 1871.
¶ Boston Medical and Surgical Journal, Vol. VII., pp. 12 and 238. 1871.
** Boston Journal of Chemistry, Vol. V. 1871.

through and confined around zinced pipes. In this analysis they state the amounts of oxide and carbonate of zinc found in the specimens, and remark: "It is proved by our investigations that the use of galvanized iron service-pipes in conducting Spot Pond water is highly dangerous to health, and should under no circumstance be permitted." An associate of the medical attendant in the above-mentioned cases made a *post mortem* examination in the fatal case, and reported that he found evidences peculiar to zinc poisoning, though he does not state what these appearances were. As no other fatal case is on record, the accuracy of observation, in this instance, may, with good reasons, be questioned. The history of the cases alluded to does not furnish evidence adequate to establish the correctness of the opinion given as to the nature of the illness, in the way of cause and effect.

In another case, communicated by Dr. Bronson, of Attleborough, Massachusetts,* the indefinite symptoms, presented in the report, would point as well to other causes as to mineral poisoning. It seems impossible that in less than two months,—the period in this instance,—symptoms such as described could have been developed by the comparatively small amount of the metal which would be received into the system from the water. Having in mind the variously confirmed facts which are presented in this paper, it must be said of this case, as of the others, that the conclusions are untenable.

From this *résumé* of opinions and facts, it may confidently be asserted, that the oxide of zinc, as it occurs in drinking-water, is absolutely harmless.

With regard to the carbonate of zinc, which is ordinarily found in water drawn through galvanized iron pipes, Vauquelin and Deyeux, Devaux and Dejaer, Orfila and, recently, Bouchardat and Fonssagrives,† were unanimous in their opinion of its innocuity. Eminent chemists, physicians and accepted authorities on materia medica and toxicology in Boston and its vicinity confirm this view. This compound has been administered internally as a medicine for many years, though not very generally, its effects being considered so slight that it has been regarded of little service. Gmelin,

* Boston Med. and Surg. Jour., Vol. VIII., p. 189. 1871.
† See works of these writers already cited.

Merat and Lens and others mention its employment in various affections, but make no reference to any injurious effects resulting from its use. Pereira remarks of its physiological effects, that its action is probably similar to that of the oxide. Oesterlen expresses the same opinion. Van Hasselt remarks, that it does not appear to be so harmless as some writers have asserted, referring to Leclaire, Chevallier and others; but he bases this opinion upon the cases reported by Bouvier, whose deductions, as we have seen, Bouchut showed to be untenable, and upon those communicated by Landouzy and Maumené, which Bouchut, Chevallier, Tardieu and others proved were not occasioned by the action of the carbonate. Dr. T. Stratton, surgeon R. N., who treated two cases of poisoning with the chloride of zinc, states,* that the best antidotes are the carbonated alkalies, which act by converting the poison into the carbonate. Ringer † asserts, that the carbonate being but slightly soluble in the animal fluids, its action on the tissues is very weak, while in large doses it produces some nausea and vomiting; that zinc does not become fixed in the body, nor does it produce chronic affections, like lead or mercury. In fact, the almost universal testimony appears to point conclusively, also, to the innocuity of this compound.

It remains for us to consider the effects of the zinc which is contained in water in a soluble condition. It has been stated in a former part of this paper, that we are unable to say positively what salt or salts of zinc are present in such solutions. In some instances, however, it has been assumed, that the chloride and the sulphate have been present. With equal reason, we might assume, in the case of many drinking-waters, the presence of nearly all the salts of zinc, the acetate, valerianate, iodide, etc. Admitting, then, that water which has been stored in reservoirs or drawn through pipes of galvanized iron always contains zinc in solution, in the form of one or more of its salts, the innocuity of these salts, in the quantities in which they occur, is attested by the experience and experiments of various distinguished observers to whom we have already referred. Vauquelin and Deyeux, Devaux and Dejaer, Orfila, Merat and Lens, Christison, Gaultier de Claubry,

* United States Dispensatory, 12th Ed., p. 1443. 1865.
† Handbook of Therapeutics, 3d Ed., p. 217. 1872.

Chevallier, Tardieu, Bouchardat and Fonssagrives, Winsor, W. R. Nichols and others, while they admit the deleterious influences which may be occasioned by the soluble salts of zinc, when taken internally in sufficient quantity or for a long time, are unanimous in the recommendation of the use of zinced iron for the storing and conveyance of water. This observation naturally suggests the inquiry, what quantity of the different salts, and how long a time, is required for the development of apparent injurious effects? It is impossible, of course, to decide these points absolutely. Approximative conclusions, however, are readily obtainable by reference to the statements and experience of reliable authorities.

Devaux and Dejaer,* in opposition to the conclusions arrived at by Vauquelin and Deyeux,* concluded, from a series of experiments made with Spanish prisoners, that the citrate and acetate of zinc, produced by the action of vegetable acids upon zinc culinary vessels, cannot exert any action upon the human system, in the dose in which they can be found in food and swallowed without being aware of their presence; that in a stronger dose they impart an intolerable flavor, which would constantly cause any aliment to be rejected in which they might chance to be found. Exceptions, however, were taken to the general application of the results of these experiments, by Orfila,* who is sustained by numerous eminent authorities,† on the ground that they were made upon persons of good constitution and in good health, and they were not tried as well with delicate subjects, whose nervous systems were extremely irritable. In the process of cooking, too, other ingredients take part in the energetic action upon these utensils, and in increasing the amount and variety of soluble salts of zinc contained in the food. Most of these authorities, however, assert, at the same time, or imply, that no danger is to be feared from the employment of zinc or zinced material for the storage and conduction of drinking-water.

The sulphate and chloride are known to be the most active poisons of all the salts of zinc; but their harmless character, as they occur in drinking-water, may be shown by reference to experience in their administration as medicines. If this,

* Loc. cit. † See various articles and works cited in previous pages.

then, is true of these salts, it will be apparent that objections to the use of galvanized iron pipes for the conduction of water, on account of the presence of the milder salts, are groundless.

The sulphate has been used for a long time in the practice of medicine. In small doses, from one-half to three or four grains, it has often been administered as a tonic and astringent. But it is observed that the system soon becomes habituated to its use, and in consequence of this fact it is always necessary to increase the dose gradually in order to obtain the desired effects. In this way, very large doses have been given. Babington* gave as much as thirty-six grains, three times a day, without producing any ill effects. Another physician reports† that he has given forty grains, three times a day, for a long period, without any ill effects. Ordinarily, however, it acts as an immediate emetic in large doses. Christison,‡ in regard to the effects of frequent small doses, remarks that he has often given, medicinally, from three to six grains daily, for weeks, without observing any particular effect, except, in some persons, sickness when the larger doses were taken. He adds, others have frequently made the same observation. In fact, it would seem that if the sulphate, which might occur in drinking-water, had any action upon the human system, it would be favorable, in the way of a tonic, rather than otherwise. As an argument, too, in support of the harmless nature of the very small doses which we have under consideration, mention may be made of the very general silence of authorities on the subject.

On the other hand, the acrid, corrosive nature of the chloride of zinc very naturally occasions a suspicion that even small amounts of it would prove injurious. But it has been administered internally, in small doses, for the relief of certain affections, when it has been considered to act as a slight tonic and stimulant. Pereira‡ observes that, taken in very small doses, no obvious effects are produced, except sometimes the amelioration of certain diseases. He states, further, that when applied externally, as a caustic, there is no danger of any constitutional disorder arising from the absorption of the

* Guy's Hosp. Reports, No. 12. 1841.

† Med. Times and Gazette, Vol. I., p. 227. 1862. ‡ Loc. cit.

poison, as is the case with the arsenical and mercurial caustics. Common testimony also establishes the fact that the system becomes habituated to the presence of this compound, so that doses of it require to be increased gradually in chronic affections; in this way, even twelve grains have been given daily without ill effects, though ordinarily one generally commences with a dose of about one-half a grain.

Oesterlen * states that, in small doses, it produces no obvious effects, being similar, in this respect, to the other soluble salts of zinc.

Van Hasselt * observes that the long-continued administration of *two to four* and *more grains* daily is reported to have given rise to affections simulating chronic mercurial poisoning, but makes no mention of ill effects from more minute doses.

Indeed, there seems to be no authority for the assumption that the chloride is injurious, even if it be allowed that the greater part, or the whole, of the zinc, which occurs in solution in water drawn through galvanized iron pipes, is in this form. Further, the fact must be borne in mind that the zinc salt or salts in this water are in an extremely dilute condition,—usually but a small fraction of a grain of metallic zinc being detected in the gallon. Now, it has been estimated * that a healthy adult man consumes a little over four and a half pounds of water daily, in food and drink, or a little less than four and a half pints (apothecaries'). If, then, a given water contained, in solution, one grain of zinc salts to the gallon, which would be absolutely exceptional, only about one-half a grain would enter the stomach in twenty-four hours; and it has been shown that any of these salts may be taken in larger doses, three times daily, with slight, if any, effect upon the system.

Notwithstanding the prejudice existing in a few localities (which we have shown to be unsupported by the facts), against the use of zinced pipes, the general opinion is decidedly opposed to the idea of danger from their employment, and this fact is attested by the constantly increasing demand for such pipes. In Philadelphia alone, where there are five establishments for the manufacture of galvanized iron, about

* Loc. cit.

† Treatise on Human Physiology. By J. C. Dalton, M. D. 3d Ed., p. 70, 1864.

five million feet of pipe were sold during the year 1873 and sent to different parts of the country.

Inquiries addressed to the superintendents of the water works of Salem, Beverly and Cambridge, Massachusetts, and of Portsmouth, New Hampshire, where galvanized iron pipes have been used extensively for several years, have elicited replies, based upon the observation of the writers, the opinions of the water consumers and of reliable physicians and chemists whom they have consulted, to the effect that the use of these pipes is unattended with danger to health. The following extract, from the communication of Mr. D. H. Johnson, Jr., superintendent of the city water works in Salem, will serve to illustrate the general opinion expressed in the above and other communications received by the writer:—

"It is only my province, as a practical man, to give you facts. We have, upon these works, 4,300 services inserted to the walls of buildings, containing 128,500 feet of galvanized iron pipes, or say 24 miles. There are as many more feet of pipes inside the walls of the houses, running (as is generally the case) across the cellars to the back part of the houses, and then up to the draw-faucets in the sinks and to tanks in the top of the buildings. In round numbers, it is safe to say, 48 miles.

"Our medical men in this city have been consulted during the past five years upon the subject, and they have failed to trace, even in a single instance, any disease arising from, or to find any evidence of injurious effects from drinking-water drawn through such pipes."

In the extensive zinc and galvanized iron manufactories of Europe, practical experience and expert testimony * have demonstrated conclusively that the workmen suffer no deleterious effects which could be ascribed to the zinc to which they are exposed in various ways. The same is true of the galvanizing works in this country. In reference to this point, communications have been received from the directors of large establishments in Philadelphia and Pittsburg, Pennsylvania, stating that "the workmen employed are as stout, strong, healthy and able-bodied men as can be found in any of our iron mills," and that none of them have ever been affected with any sickness which was attributed by themselves or physicians to the effects of the zinc to which they

* Consult papers by Bouchet, Chevallier, Levy, Hirt and others, loc. cit.

are constantly exposed. Some of them have been employed in these and in European manufactories for twenty years and more, without having experienced any ill effects, and still do a good day's work.

Many entertain a suspicion that the use of these pipes and tanks may be dangerous, in consequence of the poisonous impurities which, it is said, the zinc coating may contain.

It is known that zinc ore contains many impurities. In the process of smelting, however, it is freed from these to a great extent, though not completely, and commercial zinc or *spelter* is never absolutely pure, but contains, generally, traces of sulphur, iron and arsenic (Brande and Taylor). Other authorities also mention, in addition to the above, lead, tin, cadmium and carbon. In the process of galvanizing iron, again, these impurities become separated from the zinc to a still greater extent, so that the zinc coating contains but the merest trace of them. The essentials of this process have been given before. The zinc is placed in large vats, generally holding about twenty tons, and subjected to a heat of about 740° F. This heat necessarily expels nearly the whole, if not all, of the remaining sulphur and arsenic which were not separated from the original ore by the primary smelting process. At the same time the contained lead, iron, cadmium, etc., are melted with the zinc, but are rapidly deposited at the bottom of the vat, in consequence of their greater specific gravity. These precipitated matters form a waste, called the "dross," which amounts, in each vat, to six or seven thousand pounds weekly, and is shown by analysis to be composed as follows:—

Zinc,	94.88
Iron,	3.55
Tin,	1.00
Lead,	.30
Balance of other metals,	.27
	100.00

The specific gravity of this dross is 7.06, while that of ingot zinc is 6.86. Now, as all iron is zinced from the top

of the vat, it does not come into contact with these impurities, which are at the bottom, and hence the zinc coating can contain but mere traces, if any, of them; at all events not enough to be the occasion of any deleterious effects upon the human system.

Most of the galvanizing in this country is done with the German spelter, which is preferred by manufacturers to the American article, notwithstanding its increased cost, "because it is thought to make the best finish, running brighter and thinner on the iron than the product of our native mines." Now this German zinc contains usually, according to numerous analyses, but a fraction of one per cent. of lead, the only ingredient which can possibly be the occasion of suspicion. As the greater portion of this minute quantity is precipitated to the bottom of the vats, the still more minute quantity which is present in the zinced product, evidently is unworthy of attention in the way of its endangering health.*

To recapitulate: it is proved theoretically, experimentally and practically that zinc is acted upon by ordinary drinking-water; that water, allowed to stand in reservoirs or drawn through pipes of zinced or galvanized iron, usually contains an appreciable amount of zinc, more or less, according to various influences; that the zinc, contained in the water, is in the form of undissolved oxide and carbonate and of dissolved salts, the exact nature of the latter not being known; that probably under no circumstances is the oxide or the carbonate an active or gradual poison, much less in the amounts in which they can occur under the conditions mentioned; that, at least with water fit for drinking purposes in other respects, the contained zinc salts in solution do not exert any deleterious effects upon the human system; finally, that, even if all the zinc in solution were in the form of the chloride, which is known to be the most active poison of the zinc salts, the amount would still be insufficient to endanger health.

* Compare Rep. of State Board of Health of Mass. for 1871, p. 42, as to amounts of lead required to produce injurious effects.

HEALTH OF TOWNS.

HEALTH OF TOWNS.

The information given under this head is, for the most part, contributed by regular correspondents of the Board, in the various towns and cities. It is the wish of the Board to be informed at all times of the occurrence of epidemics in any part of the State, of the existence of any exceptional forms of disease, of unusual sickness or mortality, and especially to stimulate inquiry concerning the preventable causes of disease. Another purpose constantly kept in mind is, to persuade the people in the various towns to organize efficient health boards, of which one member at least should be an intelligent physician, and to support these boards in the fearless exercise of the great powers which are given them under General Statutes.

With these views, an extensive correspondence has been kept up with the towns and cities. We are very far, as yet, from being made acquainted with the condition of public health in all parts of the State, but each year adds to the amount of this knowledge.

In some instances, when it was made known to us that unusual forms of sickness were prevailing in certain localities, a special investigation has been made. The results of two such inquiries are given in the following pages, under the heads of "Medford" and "Spencer." Others were also undertaken, which led to no results worthy of present record. The investigation by Dr. Draper, in the town of Spencer, is referred to in the General Report.

The Board having heard rumors that an epidemic of typhoid fever was prevailing at Medford, and that it had been caused by the typhoid contagion conveyed in milk from a dairyman's premises, requested Dr. A. H. Nichols to visit the place, collect the facts, and report thereupon. As such epidemics

have recently occurred in England, it was thought desirable to decide whether the Medford epidemic originated in this way. The thorough manner with which Dr. Nichols has performed the task, shows that it has been owing rather to the filth surrounding the houses, and possible contamination of the water. There is no sufficient proof that it originated from milk. Possibly the whole epidemic might have been prevented if the simplest sanitary precautions had been taken in the various houses. There are many such homesteads in Massachusetts, and those who occupy them may find a warning in this investigation.

It will be seen that some of our correspondents have given very complete and instructive accounts of the state of public health in the towns of their residence.

A circular was issued in November, in which the following questions were asked:—

1. Whether any forms of disease have been specially prevalent.
2. Whether you can discover any cause for such prevalent forms of disease.
3. Whether such causes are, in your opinion, in any degree preventable or removable.
4. Are the local health authorities intelligent, vigilant and efficient?

In reply to these inquiries, letters have been received from 154 towns. Of this number, 62 are to the effect that no forms of disease have been specially prevalent. This single statement answers the 1st, 2d and 3d questions. About half of this number reply to the 4th question, but as they are generally from small towns, where the selectmen are the board of health, and seldom concern themselves about health affairs unless small-pox makes its appearance, the information conveyed is not of much value.

The remaining 90 correspondents speak of the boards of health of their cities and towns very freely, and for the most part we forbear to quote their remarks. More than half of the number are very uncomplimentary to the health authorities. No doubt can be left on the mind of any one who ex-

amines these letters that the boards of health of most of the cities and towns of Massachusetts have no idea of the responsibility which belongs to their office.

Amesbury.—"Small-pox to a moderate degree, measles in a severe form, and enteric diseases during a few weeks in midsummer, were the prevalent diseases. The causes of the severity of the measles are represented as excessive heat and moisture, with sudden changes, affecting bottle-fed babies more especially. Lack of vaccination and re-vaccination promoted the spread of the small-pox."

Amherst.—"Typhoid fever has been quite prevalent; next, diseases of the respiratory organs and enteric diseases. In the spring of the year many children took on a condition of great depression, with slow pulse, great restlessness, sighing respiration, etc., *resembling that of epidemic cerebro-spinal meningitis*, of which disease there were several cases in this vicinity at that time. The pulse, in one case of undoubted pneumonia, with no other complication save this depression, remained for several days at 58. The typhoid and enteric diseases have been accompanied with a tendency to functional disturbance of the liver.

"The causes of typhoid fever are mostly local and preventable. There is too much indifference to drainage, the care of sink-drains, privies, etc. Yet cases have occurred where no fault whatever could be found with the surroundings, and the causes have been unknown. Several cases can only be accounted for on the theory of contagion or infection."

Ashburnham.—"Typhoid fever has been specially prevalent. In most cases improper drainage or a privy near the supply of water is the cause. These causes would be preventable if the health-laws could be enforced."

Athol.—"We have had a remarkable degree of good health. There has been no prevalent disorder; that is, nothing more than is usual in country towns.

"Our population is to some extent transient, 'floating,' and now numbers nearly 5,000. Among so great a number, comparatively speaking (for our growth is wonderful), we naturally look for various forms of disease.

"We need a board of health, and I would recommend the suggestion of legislative action in this respect. There are times when such a board could accomplish great good, and I thoroughly advise the legal establishment of such in every city and large town.

"Our board of selectmen are 'intelligent, vigilant, and efficient,' but at the same time they are bounded by the appropriations, and none such have been made as yet for the benefit of health and sanitary influences.

"If the legislature *compelled* towns to establish boards of health, *under pay*, every town could be accommodated, and the average health would be increased above the present figures. I trust you will thoroughly agitate this subject vigorously, and be successful."

Attleborough.—"In 1871 and 1872, typhoid fever was rife. Four cases and two deaths occurred in one house where the well was apparently contaminated. No analysis was made, and no direct source of impurity was detected. Whether such causes are in any degree preventable or removable, I can

make no practical suggestions, except the application of the general principles of hygiene."

Ayer.—"We have had very little sickness of any kind during the year; hardly a case of cholera infantum, which was very common last year; one or two cases of typhoid, which also last year was very prevalent. Pneumonia prevails to a greater extent than any other disease requiring mention, but less this than in former years. Severe colds are common, and both these and pneumonia are caused in no small degree by poor ventilation, in sleeping apartments especially. Whether sudden changes from a small room, the air of which is charged with foul gases, into cool air with abundance of oxygen, prepares the way for congestion and inflammation or not, I am fully persuaded that poor ventilation acts as an exciting cause, and if so, it is preventable."

Boston.—The death-rate of the city of Boston is so high as to make the discovery of its causes a matter of the deepest interest to every citizen.

7,869 persons died in 1873.

The mortality of the past three years will be made evident by the following table:—

	Estimated population, supposing that annual increase since United States census is 3 per cent.	Total Mortality.	Mortality, exclusive of Small-pox.	Death-rate, including Small-pox.	Death-rate, excluding Small-pox.
1871, ...	258,041	5,888	5,860	22.82	22.71
1872, ...	265,782	8,088	7,350	30.43	27.65
1873, ...	273,755	7,869	7,567	28.74	27.64

Brimfield.—"Typhoid fever has been specially prevalent. In years past I have thought I could discover the cause of this disease; but this year, I cannot,—it prevails everywhere, in new houses as well as in old ones, in healthy as well as unhealthy locations. My impression, however, is, that dirty-smelling sink-drains occasion more typhoid than all other causes combined."

Beverly.—"Scarlet fever prevailed from January to July. Ten cases occurred in October and November. There were none in August and September. I do not know any way of protection against any epidemic of scarlatina."

Berkley.—"Measles and scarlatina, quite malignant, prevailed. The scarlatina originated from one family who had had no communication with any other person or persons who were previously diseased, but who used the water from a spring on the bank of the Taunton River which was overflowed by the tide, receiving 'putrid blood' or anything else that the water might hold in solution. Such causes are in some degree preventable or removable."

Brookfield.—"Last spring we had scarlatina and rubeola, and this fall have had some typhoid fever, but not a great amount. I can discover as a cause nothing more than what is generally observed. In some of the cases of typhoid fever, I thought they might be traced to the use of bad water for drinking and cooking purposes.

"We have no health authorities except a board of selectmen, which serves us very well in case of small-pox appearing among us. Farther than this, I have never known them to act. It appears to me that a board of health should be chosen in every town as much as a board of selectmen, that the health of the towns should be carefully looked after, and all causes of disease, as far as possible, removed."

Belchertown.—"There has been less sickness in this town and immediate section than for many years past. In a few cases of typhoid fever I have had, I have almost always found damp, dirty cellars or defective drains, and in one well-water contaminated by offal being thrown around it. Such causes are to a great extent preventable."

Cambridge.—"Small-pox and cerebro-spinal meningitis were prevalent in the early part of the year. No other diseases have specially prevailed. I cannot discover any cause for the diseases mentioned."

Chelsea.—"In the early part of the present year, we had, commencing in the latter part of April, something of an epidemic of cerebro-spinal meningitis, which suddenly subsided as the dry weather of early summer came on. We have had in our city, the usual number of typhoid fever cases during the fall months.

I think many of these cases were traceable to bad location, cesspools, privy-vaults, or cellars poorly ventilated, or some deficient drainage about the premises.

"In many cases, the local cause of trouble could be removed, and then a general or more extended system of sewerage adopted throughout the city would be an improvement to health.

"In our city, we have no 'health officer'; but our mayor and the board of aldermen attend to matters supposed to affect the health of our city. Perhaps a committee of two made up from this board, and more independent of political influences, would accomplish more."

Cheshire.—"Typhoid fever and dysentery have been prevalent. Low water in ponds is the cause, and it is not preventable or removable. The health authorities are intelligent, vigilant and efficient."

Chicopee.—"During the spring months, a large number of cases of rheumatic disease occurred, some of great severity. The causes assigned by physicians here, were: wet weather, living in damp basements, and insufficient clothing; all of which, of course, might have been obviated by change of residence, warm clothing, and more intelligent care in preventing exposure.

"During June and July spinal-meningitis prevailed, apparently epidemic, in one section of this village. This was alluded to in a reply to a previous circular.

"This disease appeared to me to have some connection, as a probable consequence, with foul vapors, arising from a stagnant pool of water from the sewage of several houses crowded with tenants, although some isolated cases

occurred in other parts of the village where I could not detect any malarial influence. The symptoms seemed somewhat rheumatic in character in most cases, though some were peculiar to that disease.

"The chief apparent cause might have been remedied by a little more energetic action of our board of health, a month earlier, so far as the stagnant pool was concerned.

"Cholera infantum always prevails here during July and August. More children die with some form of morbid discharge from the *primæ viæ*, than from anything else during summer and early autumn. The causes seem to me to be mainly these: hot, impure air, sympathetic irritation from teething, and improper diet. A very large majority of the cases occur among our foreign population, and the causes can only be removed by a development of higher intelligence among the mothers, and the enforcement of stricter sanitary measures by our corporations and health officers.

"Scarlatina, whooping-cough and measles have each had their turn among the children; but neither was extensively prevalent or fatal.

"Typhoid fever has disturbed us less than usual, and much less than it has adjoining towns. This disease occurs much oftener near certain streets here than in other localities, and I have little doubt that badly arranged privy-vaults, imperfect sewerage, damp cellars and too heavily shaded streets, are responsible for almost all these cases. In passing near the large corporation blocks, along the rear alleys, one cannot help receiving emphatic, sensible evidence of the foul odors of decomposing organic and excrementitious matters, during any of the warm months. It cannot be easily helped, with our present amount of sewerage, except by using a large quantity of disinfecting material, and by putting up high ventilating pipes connecting with every vault, and keeping the vault tight.

"Our local health authorities are the 'selectmen,' fair business-men, of average intelligence, none of them physicians, druggists or chemists, I think. I do not think that they are as vigilant to detect, or energetic to remove, causes detrimental to public health, as would be highly desirable in so crowded a village; but tax-payers are generally ready to cry out against any but the most obvious and pressing needs of reform, and without more liberal public sympathy to back them, I suppose they could effect but little more than they do, without great personal sacrifice."

Clinton.—"A catarrhal fever was very prevalent in February, March and April. It seemed to follow the 'horse-disease,' of the previous autumn, and many of the sick said, 'I have got the horse-disease.'"

Dedham.—"Typhoid fever was specially prevalent, caused by overwork. The health authorities are intelligent, vigilant and efficient."

Dorchester.—"Typhoid fever was specially prevalent this autumn. It is only during two or three years past that any but imported cases were frequent in Dorchester. Turning over the earth for water-pipes, and the use of Cochituate water, for the disposal of which there is no drainage, are possible causes."

Easthampton.—"Only a mild epidemic of scarlatina prevailed. No cause for the epidemic, preventable or otherwise, was apparent. The health authorities are active, intelligent and efficient."

Essex.—"Scarlatina of a mild type has prevailed here during the spring and summer, and a few cases still exist (November 7th). In some thirty-five cases under my own care, one death has occurred. These cases have all been confined, thus far, to one part of our village and town, extending over the area of about three-fourths of a mile. I am not able to assign a reason why it should be confined to this particular part, as it is apparently as high, dry and healthy as the section which has been exempt.

"As to our health authorities, in my opinion, they are not as vigilant and efficient as the interests of the public require."

Everett.—"Although there are no specially prevalent diseases, yet we have one sort of nuisance which has not been fully abated. John P. Squire transports his offal through the streets of this town, always in the daytime, and through the principal street (Broadway), and I often wonder we are not afflicted with typhoid more than we are. The stench is sufficient to generate typhoid dysentery. 'The rankest compound of villanous smell that ever offended nostril,' you would say.

"The selectment of the town are its board of health, and I think they are prompt in abating nuisances. When I had a seat upon the board of health, we effectually suppressed the opening of sink-drains upon the surface of the land. The case of the hotel at Mount Desert is a strong point for health officers to consider."

Fairhaven.—"Influenza prevailed from December, 1872, to June, 1873. Then cholera morbus and other affections of the bowels. From September to December influenza again prevailed. It was caused by some peculiar condition of the atmosphere during cold and sudden changes in temperature. Improved drainage would operate for the prevention of cholera morbus.

"The health authorities are not intelligent, vigilant, and efficient. The whole system is a sham."

Fall River.—"Early in the year, cerebro-spinal meningitis prevailed to a limited degree, and this autumn scarlet fever was quite generally prevalent. No cause for these was discovered.

"Our board of health is composed of the mayor and aldermen, who are intelligent men. I believe it is usual for the city marshal to represent them."

Fitchburg.—"The year 1873 has thus far been remarkably exempt from epidemic or other prevalent forms of disease in this city. Influenza and bronchial affections in moderate degree, a small amount of dysentery and cholera infantum, and a very trifling amount of typhoid fever. I have known of two families where enteric fever prevailed, evidently of local poisonous origin, from sink and privy-soil contamination. One case was fatal. It is a matter of surprise that many cases of the same character have not occurred in this city from the same causes among the tenements of the poor and filthy, where bad drainage and no sewerage exists.

"We have no board of health, except the *ex officio* board of aldermen, who have not thus far, to my knowledge, taken any official action of a hygienic or sanitive character as a board of health. Last winter, there having been three or four cases of varioloid in a remote part of the city, a spasmodic attempt was made by the city council to secure general vaccination, which failed of complete success, by reason of some disagreement between com-

mittees and those employed to do the work; a disastrous result, which would have been avoided if a proper board of health had existed and taken the work in charge."

Foxborough.—"During the whole of the winter of 1872 and 1873, there was an unusual number of cases of mumps. Many cases occurred which were undoubted second and third attacks. I know of no cause which will explain the prevalence of the disease.

"The local authorities have been equal to all occasions that have called for the exercise of their powers."

Groveland.—"I am not aware that any form of disease has prevailed in this locality the last year. We have had, in past years, visitations of typhus, scarlatina and dysentery, but I have never referred them to local causes. The local authorities in this healthy country village have never interfered, unless in small-pox.

"That my answers may not be entirely useless, I add a few words as to the health and locality, though not exactly relevant to your inquiries. I was born about four miles from here, in Georgetown, and have lived eighty-six years, the eighth of December. I have lived as a physician on this spot fifty-six years last June; on the south bank of the Merrimack, about twenty rods from the water and thirty feet above high tide. The tide flows four to six feet, running both ways, unless in freshets from above.

"We have about a hundred families along Water Street, with some variety of elevation. A small stream comes into the river near a number of houses, from a peat meadow whose ditches ought to be better drained. This whole locality bas been rather remarkable for health and longevity. In it myself and wife have lived to 85 and 87 years; Mrs. S. Parke, 87; N. Gould, 87; B. Parker, 84; I. Tenney, 80; N. Hopkinson, 83; A. Greenough, 83; Mr. Hawley, 83; I. Lyford, 84; S. Tuttle, 92,—now living. I might add, besides, the names of 50 who have died in 50 years aged from 80 to 97.

"The vicinity of a large river, streams of running water, or even green meadows, have not appeared to be injurious to health. I cannot see that fevers or consumption have prevailed at the river-side or in the valley more than on our hills. One house, so situated that a cemetery, on sandy soil, may filtrate, on a clay bed, to its cellar and well at thirty rods distance, has been unhealthy, as it must be. I think the banks of the Merrimack must compare well with any part of the country, in the health and long life of its inhabitants."

Hadley.—"We have had a little more of typhoid fever than usual, but not a great many cases and they have not been especially severe. There have been rather more fogs than usual this fall, and the weather has been very changeable. These may have had some influence. They are not directly preventable causes of disease; but with increased attention to sanitary conditions and personal care, they would be less potent for evil.

"The local health authorities perform no sanitary duties."

Haverhill.—"Cerebro-spinal meningitis and small-pox have prevailed. The former was perhaps caused by a damp, clayey soil, and damp cellars. A better system of drainage would remedy this; and a better system of isolation would be desirable in small-pox.

"The health authorities are moderately intelligent, vigilant and efficient. No 'regular' physician is on the board of health."

Hingham.—"Taking the year through, the public health has been good. Typhoid fever, which prevails to some extent every autumn, we have been unusually free from.

"The selectmen act as a board of health, and they appear to be fully alive to the interests of the town in this respect."

Hinsdale.—"Typhoid fever has prevailed; principally among the Irish population, operatives in mills, who live in crowded tenements and do not observe to any great extent the hygienic rules of health. No other cause for the disease has been observed.

"The health authorities are moderately intelligent, vigilant and efficient."

Hopkinton.—"No forms of disease have been specially prevalent, except, recently, a severe form of bronchitis ('influenza'). The peculiar state of the weather, and want of preparation for the early winter, may have had something to do with this prevalence. Of course the people may be more careful about their clothing and exposure.

"The local authorities are as intelligent, vigilant and efficient in matters of health as boards of selectmen in country towns usually are."

Hyde Park.—"No forms of disease have been specially prevalent in the year that has passed. Scarlatina, pneumonia and typhoid have occurred in sufficient number of cases to justify the term *frequent,* but I cannot say that they have been specially prevalent.

"The cases that have fallen under my observation, have not appeared to follow any law by which their appearance could be systematized or in any way accounted for. Scarlatina has appeared almost entirely in sporadic cases where contagion did not appear possible, and, when so occurring, has seemed to exhibit no special tendency to extend itself by contagion, and has been of a mild type. Malignant cases have been very few.

"Pneumonia has presented nothing unusual, occurring after sudden and extreme changes of temperature, and after unusual exposure. But it has presented no indications of special interest in the investigation of sanitary conditions.

"Typhoid has occurred in locations and in conditions as favorable to health to any in our vicinity, while neighborhoods where less attention has been paid to proper sanitary precautions, have not been visited with any extraordinary frequency or fatality.

"Other forms of disease have presented no marked features; and the year has been rather better than the average in respect to the health of this community. Consumption probably stands at the head of the list of fatal diseases, but it occurs in all classes and conditions, the only cause apparently operating in all cases being the very changeable climate to which we are all subject.

"'Are the causes of prevalent diseases in any degree removable?' I do not know by what means. A considerable portion of our territory is low and wet, and many cellars are very damp. If proper drainage could be effected, as much might be expected from it as from any other means.

"The general opinion is, that the local health authorities are intelligent, vigilant and efficient."

Lawrence.—"In reply to your inquiry, whether any forms of disease have been specially prevalent in this city during the past year, I have to report

the occurrence of a number of cases of cerebro-spinal meningitis. Some of them were typical cases of the gravest forms of the disease, and terminated fatally in a number of instances; while many were of a milder character, having little or no tendency towards a fatal result, recovering spontaneously, or with little aid from medicine. I am unable to give any satisfactory information concerning the causes of the prevalence of cerebro-spinal meningitis. It did not usually appear to derive either its remote or its exciting causes from any influence arising from locality, although a few cases appeared amid surroundings which more than suggested the opinion, that the vitiated air of ill-ventilated rooms was instrumental in developing the disease.

"During the midsummer months, dysentery of a severe type prevailed quite extensively in one portion of the city. The mortality from this cause was quite large, but I have no means of determining the ratio of the fatal cases to the whole number.

"Of the six wards of the city, only one, ward five, suffered in any notable degree. Indeed, all other parts of the city were remarkably exempt from dysentery during the past season.

"The mortuary record in the city clerk's office, shows that there were eighteen (18) deaths from this cause in the entire city, between June 1st and November 1st, 1873; of which thirteen (13), more than two-thirds, occurred in ward five. This ward contains an extensive area of low, swampy land, situated upon the left bank of the Merrimack River. From its westernmost point it extends easterly along the river for a distance of half a mile, and then, leaving the river at nearly a right angle, it runs northerly for two-thirds of a mile. Its width varies from one hundred and fifty to three hundred yards.

"From the inner angle thus formed, and from the western line of the swamp, "Tower Hill" and other high lands rise more or less abruptly.

"The swamp is intersected by streets which have been made by 'filling in' gravel taken from the bordering highlands.

"The land intervening between these streets being for the most part ungraded and undrained, is covered alternately with still-water and decaying vegetation.

"The natural outlet of the water of the swamp is into the Merrimack River on the south, and the Spicket River on the north, but the descent is so slight, and the land so low, that it is never completely drained. One part of it is constantly covered with still-water, while another part is always wet and spongy, and still another part is alternately wet and dry. During high water, in the spring, all the ungraded surface of the swamp is flooded, but during the remainder the condition varies according to circumstances. That portion of the territory which becomes comparatively dry, exposes to the sun a rank growth of coarse grasses and other forms of vegetation indigenous in wet soils, which, during the decomposition that ensues, fills the air with an odor often quite offensive, and necessarily deleterious to the health of those compelled to inhale it.

"It was among the population of this section of the city that dysentery chiefly prevailed during the past summer. Many of the deaths occurred in houses situated in streets traversing, or contiguous to, the worst portion of the swamp.

"As the records do not show that dysentery has been conspicuously prevalent in this ward in former years, it is probable that the exciting cause of the disease was due to some peculiarity of the season, which aroused into fatal activity influences ordinarily dormant.

"The spring of 1873 was cold and late, though not very wet. The month of June was quite hot, but on the whole the summer was rather a cold one, though there was very little rain-fall.

"The swamp was consequently unusually dry, and the decomposition of the vegetation more active than occurs in ordinary years.

"Whatever may have been the exciting causes of the disease, the limitation of the endemic to this peculiar section of the city proves the existence here of an influence potent for evil to that unfortunate portion of our population who are within its reach; and we have the startling fact before our eyes that the city of Lawrence has permitted to exist within its limits and almost within its very heart, a nuisance which is liable, at any time when favoring circumstances shall coöperate, to be converted into a fountain of disease and death.

"Fortunately, the board of health of the city, at the head of which is the mayor, have investigated the subject, and, influenced no doubt by the experience of the past season, have found sufficient cause to condemn the swamp as a 'nuisance,' and have ordered it to be abated in the only feasible method, viz.: by filling it up with gravel from the neighboring banks. This is being done by some of the proprietors of the land, and I have no doubt our efficient mayor and his colleagues of the board of health, will enforce the execution of their order, and that in a few months the 'nuisance' will be wholly abated."

Lee.—"On the 17th of last May, I was called to a family consisting of seven persons, in the adjoining town of Becket. Three members of this family,—the mother, a daughter, a son, fifteen and seventeen years old, respectively,—had already been suffering several days. They had been seized with abdominal pains, speedily followed with swelling of the face, especially about the eyes, and a little later, with muscular pains in various regions of the body.

"At the time I first saw them, there were moderate febrile symptoms,—loss of appetite, increased temperature and quickened pulse (which, in the daughter, was 105), with gastric irritation, but no diarrhœa. They each told me that the gastric pain which they had at first, had to a great extent passed off. There was redness of the mucous membrane of the mouth and fauces, some puffiness of the face and moderate injection of the conjunctivæ, and pretty general muscular pains. The son complained especially of pain in the lower limbs, and the daughter of pain in breathing. In answer to my inquiries, I learned that three weeks previously, they had purchased a barrel of slaughter-house pork, consisting entirely of rumps (each piece, of course, from a different animal), of which they had eaten several pieces. Two children, one three and the other six years old, who had eaten no pork, and an older son in an advanced stage of phthisis, whose only diet was milk, and the father, who was absent when the first three or four pieces were eaten, had escaped. The mother asserted, however, that none of the meat had been eaten raw; that she had read of the 'flesh-worm,' and always cooked her pork. On a subsequent visit, she told me that her two sick children had acknowledged that they had eaten some of the meat raw, on one occasion, and I myself noticed some time afterward that her manner of cooking pork was such that trichinæ might readily escape destruction, the pieces being thick and not very thoroughly fried.

"Their pains grew no worse, were tolerably controlled with anodynes, and in about ten days, began to pass away. Early in July, I was called to

another member of the family. I then found the mother entirely recovered, the son working in the hay-field, but complaining of some stiffness of the lower limbs, and the daughter still complaining of a little pain in breathing.

"I procured specimens of the remaining pieces of pork on my first visit, which were examined microscopically by Drs. Paddock and Adams, of Pittsfield, without finding anything suspicious. From the symptoms, however, and the so probable connection between cause and effect, I considered them as moderately severe cases of trichiniasis, and have reported them as such. I did not resort to the only positive way of decision, procuring particles of muscle from the patients themselves,—a not very pleasant procedure, and which I thought not justifiable in these cases."

Leverett.—"Typhoid fever has prevailed, and cholera morbus; the former in September and October, the latter in July and August. Almost all the typhoid fever was on the line of a brook, where there were several mill-dams. There are no preventable causes, as I can see.

"We have no local health authorities."

Lexington.—"Dysentery was quite prevalent. Filth, sink-drains and privy-vaults upon the surface of the ground, poorly cared for, were the influences that seven-eighths of my patients had to contend with. A few cases occurred in well-ordered families.

Lincoln.—"There has been very little sickness of any kind during the year. No particular form of disease was prevalent. The health authorities are intelligent, vigilant and efficient."

Lowell.—"Cerebro-spinal meningitis and scarlet fever have prevailed.

"Bad drainage, neglected vaults and cisterns, ill-constructed wells, poor ventilation, crowded dwellings, filthy habits of living, dirty back alleys and a defective night-cart system, damp locations, are the causes.

"Some of these causes are readily removable.

"The health authorities are intelligent, vigilant and efficient, to a certain extent. Mr. Sanborn, of the city board of health, is especially interested in sanitary matters.

"*Cerebro-spinal disease.*—I have heretofore made a special report on this subject. I will only say here that, out of the thirty-seven deaths from this disease, which took place from January 1st to December 1st, 1873, twenty-seven occurred between February and the last of July, and that the weight of the epidemic fell upon the months of April and May. Since August 1st, there has been a material decline in the number of cases. The blue spots on the accompanying map mark the sites of sixteen cases, the only ones I have observed to occur near water-courses, and in water-saturated soil.

"*Scarlet fever.*—In 1872 there were nine deaths from scarlet fever. This year there have been, up to December 1, 44. The disease seems to have been epidemic during the months of August, September and October in a certain district, situated partly in the fifth and partly in the first wards, and including perhaps the most unhealthy part of the city. Twenty-three of the 30 deaths recorded in three months occurred in this district. Of the 17 deaths in October, 10 took place in the red triangle in the northerly part of this map. Little and Hanover are the only streets in this district which are without sewers. No special cause can be assigned for this epidemic. I neglected to say that 35 out of the 44 fatal cases were interred in the Catholic cemetery.

"*Small-pox.*—There have been only four cases of small-pox during the past year. These were promptly removed to the city small-pox hospital, and all of them recovered.

"*City Board of Health.*—What was said of the health authorities of Lowell in the last report of the State Board of Health (page 409) cannot be applied to the present board of health; for, while little was done last year by the old board, the present organization has been quite active. The present board is composed of the mayor and four councilmen, to each of whom has been assigned the sanitary supervision of a ward. During the past year domiciliary visits have been made, landlords have been prosecuted, overflowing vaults cleaned, and seven hundred loads of refuse taken from back streets and alleys, under the eye of an officer detailed for this special service. But, with all this activity, I can point out nuisances which are yet unabated. What is needed in the city board of health is one or more medical men. This need is so obvious that no argument is required to prove it; but better than all this would be a distinct health department, under a salaried superintendent. A bill providing for such a bureau was drawn up this year, by Mr. Sanborn, of the present board of health, but was rejected on account of the expense, which would have been not far from $1,500 per annum.

"*Sewerage.*—The system of sewerage in Lowell has always been notoriously imperfect. In many places there are no sewers at all; in others the pipes have been of insufficient capacity, or not low enough in position. There has also been great confusion as to their location, owing to the imperfection or absence of maps. The space included between the blue line opposite the red triangle above mentioned has, for years, been considered particularly unhealthy. Two years ago there occurred here, especially on Marion and Cross streets, an epidemic of typhoid fever. At that time, and since then, the sewage filled many of the cellars. On investigation, a mass of filth was found which filled the entire calibre of the drain-pipe for some distance. This pipe was also found to be too small, and not low enough to create a current. Now, however, a new sewer has been constructed, which will obviate these difficulties. This is a part of the new, grand system of sewerage, which will grow apace with the introduction of water. I would recommend, in this connection, a city ordinance which shall limit the depth of cellars, so that they shall not fall below the general level of the drainage-pipes.

"*Water.*—Pure water has been introduced into the city during the past year. There are many localities, however, on which this blessing has not been conferred. The red spot on First Street, on the Dracut side, in the map, marks a block where there have been six cases of typhoid fever, two of them fatal. These cases are clearly attributable to filthy cisterns, and to the impurity of the water from the well, which is in close proximity to the vaults. This is one of the opprobria of the present board of health.

"*Defective Vaults.*—These have constituted the burden of the vast majority of complaints that have been made in the board of health during the past year. The red square in the sixth ward, including Davidson and Wall streets (see map), has long been the nidus of typhoid fever, malignant erysipelas and other similar pests. Its special unhealthiness is due to overflowing vaults, absence of sewerage, dampness of location, and the general abject squalidity of its inhabitants.

"Since I have spoken of vaults, I may as well refer to our wretched night-cart nuisance. After ten o'clock, every night during four of the finest months in the year, the hordes of farmers, who are granted licenses to empty vaults when and where they please, charge upon the city in various quarters at once,

and hold the entire community under their absolute sway. It is needless to say that these operations, attended as they are with almost unendurable stenches, are a disgrace to the city.

"The new board of health proposed by Mr. Sanborn was intended to abate this nuisance. If this were the only object to be gained by such a measure, the extra expense of $1,500 would seem but a trifle in comparison with the blessing thus received by the people of Lowell.

"In closing, I will briefly allude to a self-feeding shuttle, to which my attention has been recently called by the agent of the Hamilton Mills. The shuttle in common use requires the operative to suck the thread through a small hole with considerable force, and in this way it is supposed that a good deal of lint is inhaled. The new invention renders the sucking process entirely unnecessary. The subject may require further investigation. I simply call your attention to it now.

"Notice on the map another crowded and unhealthy locality, on Winter and Davis streets, in the fourth ward, not far from South Common, marked by red lines. Also a red spot in the same vicinity, off Gorham Street, where I saw three cases of typhoid fever, one of them fatal; the stench from the vaults in this vicinity was very great."

[Our Lowell correspondent refers to a map which is in possession of the Board. SEC'Y.]

Lynn.—"The year has been exceptionally healthy. Very few cases of zymotic disease, and those of a mild form. The mortality from typhoid, cholera infantum, diarrhœa and dysentery, 91, as compared with 188, in 1872.

"The local health authorities are intelligent and vigilant. A very efficient system for the removal of garbage and filth of all sorts has been inaugurated and well sustained by the people generally. The action of the authorities during the recent epidemic of small-pox was prompt and effectual. This was mainly due to the energy of the city physician. Little attention is paid to the ordinary routine duties of this department. The responsibility is left mainly with the city marshal, whose duties and the limits of whose authority are ill-defined. This matter has recently been a subject of discussion in our local medical society, and a committee has been appointed to memorialize the city authorities for the appointment of a board, with powers similar to that of Boston."

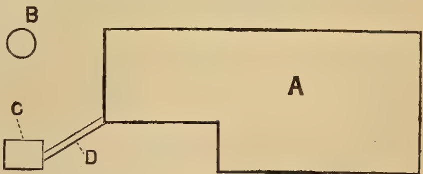
Marblehead.—"The amount of sickness has been rather less than usual during the past year. Scarlet and typhoid fevers have prevailed at times; but I am surprised at so few cases of typhoid fever, considering the insufficient sewerage and water-supply, both of which are poorest in the most thickly settled districts. The Wenham water is now as far as the Forest River Lead Mills, two miles from the town hall; but the number of ledges to be blasted would make its introduction into the town very expensive. The local health authorities are as efficient as can be expected."

The following report of typhoid fever in Medford is furnished by Dr. Arthur H. Nichols, of Boston, who was requested by the Board to make a special investigation of its causes.

MEDFORD: EPIDEMIC OF TYPHOID FEVER.—In the early part of August, of the present year (1873), an epidemic of typhoid fever appeared in this town. It so happened that about this same time disclosures were being made public with regard to the transmission of typhoid fever in London, Armley and other localities in England, through the vehicle of milk, and from the circumstance that in this town (Medford) the disease was known to originate in the family of a dairyman, the impression soon became firmly fixed in the minds of certain friends of the sick, that the cause of the rapid spread of the malady might be traced to the milk-supply coming from the infected farm. This rumor having reached the State Board of Health, I was requested to inquire into the matter, and having made several visits to the town, and examined the sources of the outbreak, I herewith report the result of my investigation.

Medford is one of the early settled towns of this State, about four miles distant from Boston, and occupying the northerly bank of a small river. It contains, according to the census of 1870, 5,733 inhabitants. An abundant water-supply has recently been introduced from Spot Pond, but wells continue to afford by far the greater part of the water used for drinking. The drainage of the town is very defective, no sewers having been constructed except in a few of the streets situated in the older part of the town, open cesspools abounding even where the neighborhood is thickly populated.

The first case which occurred in the present epidemic was that of a young man, aged eighteen, who had been employed in a provision store, where he was obliged to spend a considerable portion of the time in a damp, cold cellar, so that he was frequently exposed to wet feet. This man, who lived in the family of his father, a dairyman, was taken ill August 7th, and died September 22d. Between August 7th and September 1st, three other houses were invaded, between which and the dairyman's house no connection whatever could be traced. Upon September 1st, a second case was observed at this suspected milk-farm, which was followed by a general outburst of the disease in different parts of the town. Three cases of the fever have occurred in all in this household, besides which, the dairyman himself has been the subject of a severe enteritis, and inasmuch as this was one of the households in which the fever was exceptionally localized, I thought it important to make a careful examination of the premises, the description of which will be more easily appreciated by reference to the accompanying rough sketch.



A. Dwelling. B. Well, with pump.
C. Open cesspool. D. Drain.

Immediately in the rear of the house was situated the well B, and also an open cesspool C, consisting of a simple pit five feet square and three feet deep, communicating with the sink by means of a board drain D. The distance from the well to the cesspool was fifteen feet. The soil occupying the intervening space between the well, cesspool and drain consisted of surface-mould resting upon sand, beneath which was a deep bed of loose gravel, all presenting but slight obstacle to the free passage of sewage. The well was found to be sunk fifteen feet deep; the sides being formed of brick laid loosely, without mortar or cement. The depth of the water in the well was two feet. The water had recently begun to rise after a long, dry season, the usual depth being about five feet. A

specimen of this water was taken to Prof. Wm. R. Nichols, whose analysis removed all doubts as to the question of actual sewage contamination.

Analysis of Water from Well connected with suspected Dairy.

[Results expressed in parts per 100,000.]

	Unfiltered Water.	Filtered Water.
Ammonia,	0.0020	0.0020
"Albuminoid ammonia,"	0.0400	0.0066
Solid residue, Mineral,	30.40	29.24
Solid residue, Organic and volatile matter,	9.80	6.20
	40.20	35.44
Chlorine,	10.00	–
Equivalent to chloride of sodium,	16.48	–

[Same results expressed in grains per United States gallon.]

	Unfiltered Water.	Filtered Water.
Ammonia,	0.0012	0.0012
"Albuminoid ammonia,"	0.0233	0.0039
Solid residue, Mineral,	17.75	17.07
Solid residue, Organic and volatile matter,	5.72	3.62
	23.47	20.69
Chlorine,	5.84	–
Equivalent to chloride of sodium,	9.62	–

The specimen contained nitrogenous organic matter in suspension, and upon standing, a copious dark-colored sediment was deposited, containing organized nitrogenous matter.

The following table contains a list of all the known cases of fever occurring during the epidemic. It indicates the age and sex of the patient; the source of the water-supply of the house in which the patient resided; the fact whether or not the milk was procured from the suspected dairyman, and the date when the first decided symptoms were noticed. These data have been furnished me by the physicians practising in the town, through whose courteous aid this inquiry has been much simplified.

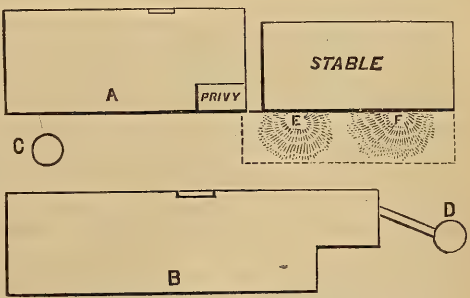
No.	Age.	Sex.	Illness dated from—	Milk-supply from suspected dairy?	Water-supply.	Result.
1	18 years.	Male.	Aug. 7.	Yes.	Well.	Fatal.
2	28 "	Female.	20.	No.	"	Recovered.
3	40 "	"	28.	"	Spot Pond.	"
4	30 "	Male.	28.	"	" "	"
5	54 "	Female.	Sept. 1.	"	" "	"
6	20 "	Male.	1.	Yes.	Well.	"
7	18 "	"	2.	No.	"	"
8	4 "	Female.	3.	Yes.	"	"
9	23 "	"	3.	"	"	"
10	18 "	"	4.	No.	Spot Pond.	"
11	32 "	Male.	5.	"	" "	"
12	48 "	Female.	6.	Yes.	Well.	"

No.	Age.	Sex.	Illness dated from—	Milk-supply from suspected dairy?	Water-supply.	Result.
13	19 years.	Male.	Sept. 7.	Yes.	Well.	Recovered.
14	16 "	Female.	7.	"	"	Fatal.
15	26 "	Male.	9.	"	"	Recovered.
16	30 "	"	8.	No.	"	"
17	36 "	"	10.	"	"	"
18	6 "	Female.	13.	"	"	"
19	15 "	"	20.	"	"	"
20	6 "	Male.	23.	Yes.	Spot Pond.	"
21	15 "	Female.	30.	No.	" "	"
22	42 "	Male.	Oct. 1.	Yes.	Well.	"
23	10 "	"	6.	No.	Spot Pond.	"
24	15 "	Female.	10.	"	" "	"
25	13 "	Male.	12.	"	Well.	"

NOTE.—Cases 1, 5 and 15 occurred in the one family; also cases 8, 9, 12, 13, 14 and 22, and finally, 17, 18 and 25.

An analysis of the above table shows that seventeen households have been invaded by the disease, twenty-five individuals altogether being attacked. Milk from the suspected dairy had been supplied to five of these households (including that of the dairyman himself), and to ten of the above individuals. Fifteen of the individuals attacked, included in ten households, had not been exposed to the suspected milk-supply.

An inspection of the premises where these fifteen cases occurred, revealed, in almost every instance, the existence of serious local defects, pertaining to either the water-supply, drainage or arrangement of the privies. Especially prominent were these unsanitary conditions about the dwelling in which cases 17, 18 and 25 occurred, as will be seen by reference to subjoined plan.



B. The house in which three cases of typhoid occurred.
C. Well, with pump.
D. Old well, now used as cesspool.
E, F. Heaps of manure.

The entire supply of drinking-water for the house, B, was obtained from the well, C, which well was distant but thirty-five feet from two large heaps of manure and swill, E, F, and but fifty-five feet from another well, D, which of late years had been transformed into a cesspool, receiving the entire sewage from the house. The manure-heaps and swill from the adjacent stable were distant but six feet from the windows of the dwelling, B, and the odor arising from this decomposing mass was so offensive as to render it necessary, in warm weather, to keep the windows most exposed constantly closed.

It was evident that the neighboring ground must be thoroughly charged with the soakage from the sewage and the manure, and, considering the loose nature of the soil, it seemed possible that a portion of this soakage might have percolated the ground and worked its way to the well, C. A sample of the water of this well was, therefore, obtained, an analysis of which (made

by Prof. Wm. R. Nichols) shows a considerable degree of pollution, sufficient to condemn its use.

Analysis.

[Results expressed in parts per 100,000.]

		Unfiltered.	Filtered.
Ammonia,		0.0008	0.0008
"Albuminoid ammonia,"		0.0136	0.0054
Solid residue,	Mineral matter,	16.70	15.80
	Organic and volatile matter,	5.10	4.10
		21.80	19.90
Chlorine,		1.96	–
Equivalent to chloride of sodium,		3.23	

[The same results expressed in grains to the United States gallon of 231 cubic inches.]

		Unfiltered.	Filtered.
Ammonia,		0.0005	0.0005
"Albuminoid ammonia,"		0.0079	0.0032
Solid residue,	Mineral,	9.74	9.22
	Organic and volatile matter,	2.98	2.39
		12.72	11.61
Chlorine,		1.14	–
Equivalent to chloride of sodium,		1.89	–

NOTE.—Nitrogenous matter was contained in solution.

A complete list was obtained of all the families supplied by the suspected dairyman, the number of which was seventy-five. By comparing this list with the above table, it was ascertained that, of these seventy-five families, five only had been invaded by the disease; eleven individuals in all being attacked.

The coincidence in point of time between the probable specific infection of the dairyman's well and the outbreak of the fever in cases eight, nine, twelve, thirteen and fourteen, in which the milk had been freely consumed by those attacked, surely justifies suspicions as to the possible pollution of the milk-supply, through the agency of the well-water.

On the other hand, if we take into consideration the very small percentage of the customers of this dairyman who were affected, it hardly seems within the range of possibility that any considerable portion of the milk could have been contaminated, and yet be drunk with impunity by so many individuals. Furthermore, whenever epidemics of typhoid fever, in England, have been traced to polluted milk, it has been found that the most numerous class of sufferers are young children, with whom milk forms the principal article of diet. Now, among those attacked in the present epidemic, two only were under the age of fifteen, and none under six.

In view of these facts, I have, therefore, arrived at the conclusion that the testimony obtained is not strong enough to justify any indictment of the milk-supply, the conditions under which the epidemic appeared pointing

more strongly to other sources of infection; viz., defective drainage and a polluted water-supply.

Medway.—"It has been remarkably healthy through the year. There have been a few cases of typhoid fever, of a mild type, in the west part of the town, but none in the east or in the village, unless I except a case of typhoid pneumonia, which very likely was caused by a great deal of rotting vegetable matter all around the house. It was an establishment where great quantities of squash, tomatoes and corn were 'put up in sealed cans.'"

Millbury.—"No form of disease has been specially prevalent. The surroundings of many of our factory tenements are abominably filthy. There are no local health authorities that I am aware of."

Milton.—"One family had five cases of typhoid fever; no deaths. No diseases have been specially prevalent. Damp, undrained cellar, now remedied, was the cause of the typhoid. The local health authorities are intelligent, vigilant and efficient."

Monson.—"Considerable typhoid fever has prevailed. A slaughter-house, one hundred rods, more or less, from the locality where most or many of the cases occurred, may have had an influence in causing the disease. This nuisance might, of course, be removed farther away, or be kept better cleaned and purified. The health authorities are intelligent, but not vigilant or efficient.

"The inhabitants of this town reside largely on a small stream of water running north and south, with high hills rising rather abruptly upon the east and west. I believe, did the people live upon these hills, instead of in the valley, we should have less disease, especially throat diseases and consumption."

Montague.—"I should say that no form of disease had been specially prevalent, although we have had rather more than the usual amount of typhoid fever, more than the average for the last ten years. Decaying vegetable matter was a cause. A drought in the early part of the season, followed by frequent and copious rains during the middle and latter part of the season, produced a luxuriant and rapid growth of vegetation and consequent rapid decay.

"The health authorities are intelligent, vigilant and efficient, so far as I know."

New Bedford.—"We have had no specially prevalent disease during the year.

"In regard to question 4, 'Are the local health authorities intelligent, vigilant and efficient?' I would say, that as far as my observation goes, the health authorities of this city are neither 'intelligent, vigilant or efficient.' However intelligent they may be as regards other matters, it is not probable that they would pretend to know anything of sanitary science, or of measures looking to the prevention of disease beyond the ordinary routine work on streets and sewers.

"Thoroughly frightened by small-pox or cholera, they would have perhaps some vague idea of disinfection. I am not aware that any attempt has been made to prevent the contamination of the air of the city by the effluvia from

soap-boiling establishments, though the whole western portion is deluged with the most disgusting odors when the wind is east. I have never heard of any inquiries being made concerning the water-supply of families, or of any means for the discovery and prevention of the contamination of wells by drainage from privies, sinks or other sources of impurity. Any public supervision of the building and draining of dwelling-houses with a view to their healthfulness, would doubtless be looked upon as an invasion of private rights. It is much easier to say what they fail to do, than what they do. Nevertheless, our board is probably as good as any of the kind, and as good as any we are likely to get under the present system. We have no right to expect a mayor and aldermen, chosen for political reasons, to know anything of public hygiene, and as they know nothing about it, they ought not to be expected to take an absorbing interest in it. When the public are aroused to an appreciation of the importance of this matter, we shall no doubt have a real board of health, and not a name merely."

Newburyport.—"Small-pox and varioloid were prevalent during January and February; and during the latter part of April and in May, June, July and August, measles and chicken-pox were very prevalent. In a private school, numbering about sixty scholars, every child had the measles that was not protected by a previous attack.

"Our local board of health consists of the mayor and aldermen. You must excuse me from giving a more explicit answer to question 4."

North Adams.—"Measles and whooping-cough prevailed in the early part of the season. We have been remarkably free from fevers during the past two years. We now have fever somewhat prevalent, of a low type, *taking on some of the characters of cerebro-spinal meningitis,* but not marked. I can discover no cause for it, or suggest one as probable.

"We have no local health authorities."

North Andover.—"In our town the present year, we have had very little sickness. Two cases of typhoid fever have occurred—one imported from Southbridge. There was one case of cerebro-spinal meningitis. Our cases of bowel complaints were mostly of a mild type and short duration.

"The local health authorities are intelligent, vigilant and efficient."

North Bridgewater.—"Typhoid fever has prevailed in certain localities. I know of nothing to account for it, unless it is a general deficient drainage, in sections of the town. This is difficult to remove wholly, owing to the sandy soil and level surface.

"I think the health authorities are intelligent, vigilant and efficient."

Northbridge.—"An epidemic of mild typhoid prevailed in the month of October, more extensive than for several years. I do not know of any special cause."

Northfield.—"We have had no diseases *specially* prevalent. Typhoid fever and phthisis pulmonalis are our prevailing diseases. We have our proportion of the eruptive fevers, except variola. There have been no cases of the latter during my practice in this town. I have had what I termed gastric fever, but some of my competitors, not finding it treated fully in their books, have seemed inclined to dispute the validity of the name.

"I am unable to discover any satisfactory cause for typhoid fever. Our

pulmonary difficulties are aggravated by the sudden changes of temperature and heavy fogs, to which we are subject. I know of no way to remove these causes.

"We have no local health authorities except our selectmen. I think them intelligent and efficient, though they are not tried in our country towns as they are in cities."

North Prescott.—"Influenza was prevalent in the early part of the year; some very severe cases,—at least one fatal case, an old lady. I do not think of any other disease that has been specially prevalent, except mumps and some cases of measles.

"I do not know of any causes. They all seem to be contagious, though I do not think influenza so much so as mumps or measles. There seems to be a special poison for the latter two, but the exact measure of action I am unable to determine. But that of influenza seems still more insidious.

"I think I have heard of a botanist publishing a paper on the effect of the north-west wind upon the nervous system of plants. I cannot say that I am correct, but I have been thinking that if the wind, in blowing from a certain direction, has an effect in any way upon plants, there would be good reason to expect that it might have some effect on animals. If I rightly remember, the winds last winter came mostly from a northerly direction, perhaps more from the north-east than from the north-west. Probably they were loaded with dampness, more so as regards the north-east than the north-west. And I have thought whether it might not have been a partial cause of the prevalence of the epidemic bronchitis or influenza; the breathing of air, which is *cold* and *damp*, for a long time, would, it seems to me, irritate the mucous membrane of the air-passages, and the cold and damp winds would cool the surface of the body, producing congestions in the internal organs and some degree of inflammation in the irritated and weakened mucous membrane. Also, the blood would be poisoned by retained secretions, or perhaps by the proximity (almost contact) of such atmosphere in the air-cells of the lungs, which poison would produce the febrile symptom which usually accompany an attack of influenza.

"I do not know that this theory* would hold good in the case of the epidemic among animals a year ago; yet, if I remember aright, such winds as I have spoken of were prevalent at that time, though in a less degree than during the winter. And the questions might arise why animals were affected at that time and man was not; and why man was affected in the winter and spring and animals were exempt, or nearly so. I suppose they may be answered as follows: Man represents the highest order of animal life, and diseases which are common to man and dumb animals would affect the lower order of creation first; that is, it would take a less amount of poisonous influence to affect them than man; therefore, we had in the fall of the year a milder degree of this poison, which was not sufficient in power to take hold of man. Later, we had a greater amount, which was sufficient to affect man. Why animals were exempt (or nearly so) in the latter time, and man not, may be explained in the fact that the disease seemed to carry with it, or rather to give, a certain amount of protection from a second attack. It would

* The speculations of our correspondent are given in full as tending to excite the minds of others to attempt the discovery of the obscure causes of epidemics; but it is certain that the disease in question existed over the whole continent, and that the prevailing winds of any definite place, or section, cannot account for it.—SECRETARY.

seem as though nearly every horse had the disease in the fall and early winter months. As the cause increased man became affected; and, showing the increase of the cause, we find that some horses were affected a second time. I know that this is a somewhat vague theory; but I do not know why some diseases may not be caused in such ways as well as plants be affected by the wind (if such is the case).

"In the cases of parotiditis and rubeola, isolation would help to prevent the spreading of the diseases, but would not prevent, in my opinion, those cases which seem to be sporadic.

"There has been no special call for the action of the local boards of health in this vicinity. If such were the case, I suppose they would act. We have very few cases of nuisance so prominent as to call for action by the local boards."

Oxford.—"I am happy to say that the public have been greatly favored by the absence of any specially prevalent form of disease for many months. In the winter, there were quite a number of cases of scarlatina, but most of them in a mild form. I was not able to discover the cause, although its contagious character was very obvious.

"Our local health authorities have never been called upon for much action, in any way, as we have a rather sparsely settled population. As we become a little more crowded together, there will be better opportunity to judge of their intelligence and efficiency."

Pittsfield.—"No form of disease has been *specially*, in the sense of *remarkably*, prevalent, but the following diseases have prevailed to a noteworthy extent:

"*Typhoid fever* has prevailed to about the same moderate extent that it usually does. During September and October there were fewer cases than usual, while there were more than usual in November, some of them running on into December.

"*Diphtheria.*—About a dozen cases in all portions of the town, part of them in August, and part in November and December. This disease has not previously visited the town for many years.

"*Scarlet Fever.*—Something of an epidemic, of a moderately severe character, in November and December.

"Summer bowel disorders were *less* frequent than usual. Cholera infantum very markedly less than the preceding summer.

"*Cerebro-Spinal Fever.*—One case only.

"In the cases of typhoid fever, some local cause has been generally discoverable. The following are examples:—

"A case occurred in August, in a factory tenement house, containing several families. The house stood on a slope, and was one story higher in front than in the rear. The patient's bedroom was in the second story, but being in a back room, was but little above the ground. At my first visit, I observed an offensive smell; and, on going to the open window, found that it came from a row of privies and pigpens, situated about four rods from the house, and up the slope of the hill. Being west of the house, the prevailing winds from that quarter carried the effluvia into the windows. An inspection of the premises showed that the privy used by the occupants of the house was in a shocking condition, the shallow pit under it being full and overflowing, to form a noisome heap of excrement behind. Adjoining this was a pigsty, then came a cow-house, and next another pigsty, all these forming a line parallel with, and close to the rear boundary of the lot. A

few feet beyond this row of structures, was a row of privies belonging to tenements on another street. These had no vault, and the contents oozed out upon the surface of the ground. Near these was also an open cesspool, receiving the slops and waste water from the same tenements, and covered with a green scum. It was, altogether, a remarkable combination of nuisances. The board of health at once procured the removal of these pig-pens, and of the first-mentioned privy, to a greater distance, the vault being covered up with earth. The cesspool was also covered over, and the privies near it disinfected. The case of fever became convalescent in two weeks, and was followed by no others in that locality. As far as I know, it was at that time the only case in town.

"Toward the close of August, four cases of typhoid fever appeared in Coltsville, which has been described by me as abounding in fever for several years past. Three of the cases were in a house which had three cases last year, and one or two the year before. It is a very old boarding-house, but the owner had made an effort to purify it, in the spring, clearing up the cellar, whitewashing the walls, etc. An inspection showed the house to be in pretty good condition, excepting that there was much rubbish in the attics, but exception was taken to the well and privy. The former was in the cellar, close to the wall, the surface of the water five feet below the floor of the cellar, and ten feet below the surface of the ground. The water was ten inches deep. The well was covered over with boards, and smelt very musty. The water was drawn by a pump, in the scullery, and tasted so badly that the tenants had been, at last, obliged to give it up for drinking purposes, and go to a well at some distance. The secret of this foulness was not hard to find; from the scullery window, immediately over the well, all the slops and garbage of the house (and a boarding-house at that) were thrown out upon the surface of the ground, nine feet from the surface of the water, the ground being very porous, and the descent of the noxious fluids being facilitated by numerous rat-holes. The privy was about two rods from the house, in a condition even worse than that mentioned in the preceding case, and was constantly smelt in and about the house.

"The fourth case at Coltsville, was in a large, pleasant-looking house, occupied by persons in very comfortable circumstances, and who took great pains, as far as their knowledge went, to keep their surroundings clean and wholesome. An investigation by the board of health, however, discovered an open drain at the back of the house, and but a few feet from it, by which the slops of the house slowly insinuated their way through weeds and rubbish to an adjoining lot. The privy was constructed thus: resting upon the level of the floor was a box of plank, the length of the privy, and about one and a half feet in each of its other dimensions; its top therefore came up close to the seat. This was full of offal, up to the level of the seats, the liquid portion having oozed out through the cracks into the ground. The only escape for gases was through the seats. The door opened from the wood-shed, and was found open, the kitchen door being but a few feet distant. This family used water from an artesian well, 270 feet deep.

"In November, there occurred, near the centre of Pittsfield, six cases of typhoid fever, three of them fatal, and all in the same immediate vicinity. Three of them were on low, swampy ground, adjoining a pond and brook, and three on somewhat higher ground. The various sites were these:—

"1. A tenement house, where all slops were thrown into an open ditch in the rear, which, as it did not run off freely, was occasionally cleaned out by the landlord. The patient lived on the ground floor.

"2. A house where the throwing out of slops and garbage had been such a nuisance in the summer, that the board of health had then caused a cess-pool to be dug. This case was complicated with delirium tremens, and was of short duration, proving fatal in a week.

"3. A tenement house, standing on a hill-side, so that what was lower story on one side was cellar on the other. The patient lived in the half underground story, with no cellar under it, of course, and the only windows opening to the north. The yard was far from cleanly.

"4. A new house, on a meadow, with a cellar dug in wet, clay soil.

"5 and 6. Houses situated on the same low level as the last; the sixth being within a few feet of a brook of varying height.

"The cases in the last three houses occurred after the ground had become well covered with snow.

"During November, unusually severe and fatal cases of typhoid fever have occurred in several towns, in this part of the State.

"The cases of diphtheria at ———, in August, were all of them on high ground, with no apparent sanitary defects, except one, which occurred in a house close to the border of a large pond, which was extremely low, exposing a great area, which was covered with rotting stumps and much decaying vegetable matter. The first cases, however, were on a hill, and no clue to the origin of the disease could be discovered. Two of the cases in that vicinity were fatal.

"The cases of diphtheria, in November, six in number, were all in one family, living in a house on the outskirts of the village. The first was fatal; the others recovered. The house is about forty years old, is on low ground, close to a pond, and has meadows all about it, which are overflowed after heavy rains. The soil is clayey. The portion of the house most occupied has no cellar under it, but the floor-timbers rest almost directly upon the ground. The cellar under the disused portion is dry and clean. A week before the first case appeared, an old privy-vault was cleared out, and the contents placed in heaps upon the ground, a few rods from the house. The child who was first attacked was out watching the process of removal.

"These details concerning diphtheria are, perhaps, of no value whatever; but I have thought they might, in connection with other cases, possibly prove of some interest.

"Local causes of typhoid fever are largely removable; those that are domiciliary more easily than others. We frequently find several kinds of local cause acting in concert.

"To make any house, however, perfectly pure, and to keep it so the year round, is, even with the most intelligent and wealthy class, often practically impossible.

"The sources of fever poison are so varied and subtle, and so small an amount of poison will induce fever in a system prepared for it, that cases of fever frequently surprise us in the most favored locations. What, then, must be the difficulty of *stamping out* typhoid fever in the houses of the very poor? These may be put in perfect condition, once or a dozen times a year, by the landlord or board of health; but, as soon as the tenants are left alone, out go slops and garbage from the back (or front) door upon the ground,—the nearer the well the better it seems to suit them,—while they cannot be induced to use disinfectants or dry earth in the privy regularly and persistently.

"Typhoid fever can be reduced to a minimum by sanitary measures; but, to enforce these satisfactorily will require an untiring vigilance on the part of the authorities, and a degree of sanitary education among the masses,

which they will be long in acquiring. *Sanitary science should be taught in the public schools.*

"As a member of the local health board, I am incompetent to answer one of your questions directly. The Pittsfield board of health is composed of one legal and two medical members; most of the inspections being made by one of the medical members, who is styled the agent of the board. Of him, I can say that he is remarkably well fitted for the position, and performs his duties with great intelligence, vigilance, efficiency and good judgment. The whole board labors conscientiously for the sanitary welfare of the town."

Provincetown.—"No disease has been specially prevalent, if I except the small-pox last winter and spring. Our most common disease is rheumatism. I believe the latter is owing, in a great measure, to the dampness of our atmosphere, sudden changes of the weather and cool nights. I believe by due protection with flannels or deer-skin underclothes the disease may be rendered much more uncommon, if not entirely eradicated. And here you will allow me to remark that, when I came in December, 1839, consumption among our females was very common; in fact, you could hardly find a healthy female. And the whole cause was owing to our females going improperly clothed. I had consultation with our shoe dealers relative to the manner of their shoeing. They told me they wore the thinnest shoes that could be made; that they could not sell a thick-soled shoe. My remark to them was, that the course was ruinous to their health, and that something must be done for their safety. They agreed with me, and would second any movement to effect a change. I made my views known, and such has been the success that now (1873) our females are as healthy here as in any town in the Commonwealth. And this has been effected by keeping their feet warm and taking more and better care of themselves.

"Now, I think rheumatism, both chronic and inflammatory, may be greatly benefited by care and proper protection, by suitable underclothing, from sudden changes and cool nights and damp atmosphere. If this does not do it, I know of no precautionary measure that will do it.

"If you mean by 'health authorities' our board of health, I answer they are lamentably ignorant and inefficient. So far as we are concerned, if the health officers were appointed by the governor and council, it would be a great aid to the health of our place. Or, if only one is appointed—a faithful and judicious person—to a town of our size, and located as we are, it will be sufficient. He will be willing to attend to such duties for a small compensation, and would save the town much of their heavy expenses.

"I am deeply interested in the sanitary measures which, I believe, might be adopted to affect the general health of this town through an intelligent health officer, which can never be effected by a town vote, for as people, so will be the health officers."

Quincy.—"Typhoid fever has been rather more than usually prevalent since August. While the disease has been confined to no one locality, cases having appeared in nearly all parts of the town and among all classes of our citizens, by far the greater number of severe cases occurred in one short street among the Irish residents. This street is low and level, and has no natural or artificial drainage. On the contrary, it receives the drainage of a considerable and somewhat densely populated territory on either side. About the middle of the street there is a *shallow* well, from which most of the inhabitants obtain all their water for domestic purposes.

"The local health authorities are intelligent, but are not vigilant or efficient."

Reading.—"No forms of disease have been specially prevalent, except that during July and August bowel diseases prevailed in a mild form, and chiefly among children. Dentition occurring in the hot season seemed the predisposing cause, putting the system into such a condition as to render it liable to disease under the slightest error of diet or exposure. Few were attacked while nursing a healthy mother. Intelligent care as to diet and clothing would, in my opinion, have prevented much of this sickness.

"The selectmen are the board of health in this town; they are probably as efficient as the average of such boards."

Salem.—"The forms of disease most prevalent have been cholera infantum, typhoid fever and consumption. Early in the year we had some cases of small-pox, but the number was small compared with our whole population, so that, although these cases attracted much attention, and excited no little alarm, I doubt whether we could correctly say that it had been this year a prevalent disease. So, also, we had a few cases of cerebro-spinal meningitis lifted into much prominence by the fears of the people, yet too few to constitute a prevalence of this form of disease. Consumption has not seemed to have any unusual prominence. It is, as you well know, always with us. The people have almost ceased to feel shocked, as it annually numbers many fatal cases.

"Cholera infantum was a prevailing form of disease during the months of July and August, and although somewhat less frequent than in the summer of 1872, was still a lamentable source of suffering and death. During the latter part of August, typhoid fever made its appearance in many parts of the city, and continued to be a prevalent form of illness up to the 1st of December. The health of the city during the autumnal months has been, generally speaking, good. Indeed, throughout the year there has been less sickness than during the year 1872.

"I have little to mention in addition to the well-known conditions out of which consumption, cholera infantum and typhoid fever most surely multiply their victims. But, with reference to cholera infantum, I would emphasize the fact, that after due consideration of the more common sources of this disease; viz., the artificial feeding of infants during the irritation of teething, the extreme heat of summer, the ill-health or improper or insufficient diet of the mother, there is still the greater frequency and fatality of the disease in our cities to be considered. How frequently does it happen that an infant, taken sick with diarrhœa in the city, recovers speedily on removal to the country! While it is true that infants, in all sections of a city, may become victims to this disease, it is very noticeable that the disease is most prevalent and fatal where the sickening air of uncleanly dwellings, or miasm from faulty drainage, surround the little sufferers. With favoring winds, the emanations from such localities must reach distances much greater than the limits of our city, and at times contaminate the air of even the so-called healthier districts.

"With reference to typhoid fever, out of a much larger number which have occurred, I have certain knowledge of but 84 cases. The distribution of these cases is a matter of much significance,—indicating that the houses visited are, with few exceptions, in neighborhoods where drainage or privies are neglected, or near sluggish bodies of water contaminated by sew-

age. In three cases, occurring in the healthier sections of the city, we have direct evidence that the disease was contracted at a house in the country, by drinking from a well contaminated from a neighboring barn-yard and privy. At the foot of Pingree Street is a sluggish body of water, fouled by refuse of all descriptions, which taints the air of the neighborhood with its offensive exhalations. Near this water, on low land, are tenements whose occupants use little precaution to protect themselves from the stench of slops and garbage thrown on the surface of the ground, or from shallow and neglected privies. At high tide, the waters find their way along the drain, into the cellars of the houses. It surely is not strange, that in this neighborhood, during the past year, occurred *nineteen* cases of typhoid fever. There is a sluggish basin of water lying to the north of Howard Street cemetery and the jail. This basin is of triangular form, bounded by Bridge Street, the Eastern Railroad and land lying back of Northey Street. It covers three or more acres of flats. Into it flows the drainage from St. Peter's Street, Howard Street, Oliver Street, Northey Street and portions of Bridge Street; also the drainage from the gas-works. Formerly, the coal tar from these works was allowed to flow to waste; but since it has become valuable for coloring purposes, it is retained, and only the ammoniacal liquor is allowed to flow away. So that, whereas formerly some little antiseptic action was derived from this drainage, now it aggravates the baneful condition of the waters by promoting decomposition. Each spring, with the annual clearing of gardens, flower-stalks, brush, and all sorts of refuse, are emptied along the banks of this basin. On the Northey Street side there is a low shore, overgrown with sedge-like grass. The only outlet for these waters is by a culvert under the railroad. The emptying of the waters with the ebbing tide is so slow, that decomposing animal and vegetable refuse settles among the brush and grasses on the shore and on the flats. Near the gas-works, leading from Northey Street to the basin, is Woodbury Court (a short court with five or six houses on each side). In the two houses immediately bordering the water, there have been five cases of typhoid this season. Half-way up the court have occurred two more, and not far from the head of the court three others, making 10 cases in this neighborhood this autumn.

"In 1871, in the house at the head of the court, and on Northey Street, I attended four cases of typhoid fever. In 1868, in the second house from the head of the court, I attended five cases of the same disease. Counting cases of typhoid fever which have occurred within the last five years in this neighborhood, literally within a stone's throw of each other, I have knowledge of *twenty-one* cases. I cannot avoid attributing them to drainage, which is not conducted as it should be to deep waters, where the tides can more speedily carry it away. Another locality frequently visited with typhoid (from whence I have information of seven cases which have occurred the past fall), is the portion of Bridge Street lying between Skerry and Osgood streets, together with the streets which lead from it to the North River. The land here is low. Drainage is discharged on adjoining flats, or allowed to infiltrate the soil about the dwellings.

"These basins should be filled in without delay. If the owners are unwilling to fill them at once, it becomes the urgent duty of the city to do so. I believe that the localities at Pingree Street and north of Bridge Street which I have described, could be made much safer as places of residence, and with small expense to the city. But before vigorous measures can be adopted to improve the sanitary condition of our city, the authorities must appreciate the dangers which are imminent. This neither they nor the

people seem to do. The North River nuisance remains the same, although public attention has been repeatedly called to it. If by a defect in the highway, or public bridge or building, two or three lives are lost, the community are startled, and often angrily inquire where the blame lies. But disease may silently take scores of lives annually, which might have been spared had proper sanitary measures been carried into effect, and the people seem indifferent, thinking that such deaths are to be attributed to unavoidable sickness, and sickness and death must sooner or later overtake us all.

"Our board of health is composed of the mayor and aldermen, who are not elected because of any special fitness for the duties of health officers, and when we consider the multifarious duties of the mayor and aldermen, it is not to be wondered at that they do not give the necessary study and effort to detect, appreciate and remedy many circumstances which endanger the public health. We need a differently constituted board of health."

Shelburne.—"Scarlet fever, measles and diphtheria have been very prevalent for a few months past, and scarlet fever and diphtheria were quite fatal. Another disease prevailed in June and July very extensively; about seventy-five cases in these months,—none fatal. We called it a congestive fever. No cause in particular has been discovered, unless it be a long and protracted winter.

"The health authorities are intelligent enough, but not vigilant or efficient."

Somerset.—"No special disease has prevailed the present year; but nearly all complaints have seemed to assume a typhoid form. In one portion of our town, called 'Dublin' (on account of Irish inhabitants), there have been many cases of mild, simple fever. As the causes are quite clearly known to be due to poor sewers and exposed garbage, decaying vegetable matter, etc., it is in a great measure preventable.

"I regret to say the health authorities are not intelligent, vigilant and efficient."

Southbridge.—"No forms of disease have been generally prevalent during the year; but recently typhoid has appeared in a locality not hitherto affected, and presenting such uniformity in its attacks and general course, as to force the conclusion that it is the result of the operation of a local specific cause. An inspection of the premises in and adjacent to the infected district, affords abundant evidence that this cause is due to defective drainage and contaminated water. In a row of five dwellings, occupied by 124 people, have occurred, in six weeks, 21 cases of typhoid fever, two of which have proved fatal.

"My experience and observation justify the theory of Dr. Jackson, that the vicinity of newly broken ground affords a *materies morbi* sufficient to develop local epidemics of typhoid and of dysentery. A communication of mine to your honorable Board in 1871, and published in 1872, will give the facts and observations upon which my views are based.

"In regard to the extent of territory embraced within the range of the epidemic I am now writing of, it consists of a single row of factory tenement houses, occupied wholly by Canadian French, situated on the easterly side of Foster Street, extending about twenty-five rods along the same. The houses are all of brick, except one, which is of wood. A new street has cut Foster Street at nearly a right angle, through a low piece of marshy

ground that has been ditched and ploughed this year for the first time; to this I was inclined before inspection, and upon information I considered good to attribute the prevailing disease, being informed that all drains, cellars, water and privies were in good condition. But ocular examination furnished sensible proof that my information was incorrect.

"I wish that the people could see more clearly the necessity of sanitary reforms, before death and destruction prove the dire penalty of neglect and apathy in regard to serious causes of disease throughout our villages. I set a high value on the information that is being furnished by the labors of your Board, and hope to impress at some time upon the public authorities, the necessity of two things to make our local sanitary efforts more successful; viz., requiring in all organizations the coöperation, either as advisory or with executive powers, of at least one intelligent physician; and, secondly, the need of more ample power to be exercised by the board itself; though perhaps their unpleasant duties never will be faithfully performed so long as the body is composed of members who owe their powers to a popular election.

"Other causes of local disease, besides those above alluded to, do now exist, and have for a long time existed, in other parts of the town, plainly preventable, but which are suffered to exist as the causes of disease and death, through the lack of 'pluck' in the local authorities. For example, complaints are made of nuisances as annoying to the senses and personal comfort of the complainants as they are detrimental to public health; hearings are had, orders to suppress issued, and there the whole matter fails for want of energy on the part of the board of health to enforce their own decrees.

"Let me cite one instance. Through the main street of the town, and beneath two of the largest blocks, runs a brook formerly well supplied with water, but now dry, or nearly so, an average of six months of the year. This brook receives the sewage of a large part of the village, running for sixty rods within a few feet of the most densely populated parts of the town; during the dry season, and for fully half the year, the current is insufficient to carry off the accumulated mass of filth, and it lodges and contaminates the atmosphere and the sources of water-supply to a fearful degree. Complaints for two successive years have been filed with the board of health, and orders issued by it for the suppression of the nuisance, but no one obeys the order, and the evil continues, and will, probably, until an epidemic ensues sufficiently frightful to move the fears of the people, and impel them to rebel against such supineness and inefficiency."

South Dennis.—"During the past year there has been no prevalent disease, except a mild form of scarlatina. It came from Providence, R. I. A family returning home from that place had children taken with the disease a few days after they arrived. In about six days, some four or five children were taken with scarlet fever. There had been none in the place for over a year. None of the children taken had seen the sick children from Providence. I know that many doubt the fact of scarlet fever being so very contagious, but I think I have seen facts enough to convince me that if the fever is anywhere within a quarter of a mile, those that have not had the disease *may take it.*

"Our officers of health are all that is required."

South Hadley.—"Disease of the nervous system has been the more prevalent. Very few of any other character. I do not discover any cause for the former.

"The local health authorities are intelligent, efficient and vigilant."

South Scituate.—"This has been an unusually healthy year. No special epidemic has visited us the present year. Since June, we have had more than the average of typhoid fever, yet not as many cases as last year.

"I cannot trace its unusual prevalence last year and this to any special cause; cases have appeared here and there, often several miles apart, some upon high land and some upon low.

"The selectmen are the board of health."

Southwick.—"Typhoid fever has prevailed rather more extensively than is common in this usually very healthy town. No other form of disease has been specially prevalent.

"Four cases in one family were *perhaps* caused by a cesspool leaking into the well, the two being only a few feet apart. In other cases, the only filth that could be discovered about the premises was the wash-water of the house thrown on top of the ground near the back door; which is the usual way throughout the town of disposing of such water. Refuse vegetable matter is disposed of by our scavengers—the hogs.

"Greater care in removing filth from the vicinity of the house would, in my opinion, prevent, in some degree at least, the prevalence of typhoid and other diseases.

"We have no acting local health authorities."

"*Spencer.*—

"BOSTON, November 15, 1873.

"Dr. GEORGE DERBY, *Secretary of the State Board of Health.*

"DEAR SIR:—I beg leave to report the following facts concerning the recent outbreak of small-pox in Spencer, the inquiry having been made in conformity with the authority conveyed in your communication of October 26th, ult:—

"The disease made its appearance in the town, on or about the first day of June, and the last case was discharged from the hospital on the 29th of August, of the present year. In this interval, there were 71 cases, including both variola and varioloid, in all degrees of severity. There were eight deaths, being eleven per cent. of all the cases. The persons attacked were mostly children; and the disease confined its ravages entirely to the French Canadians, of whom there are about 2,000 resident in the town.* Four of the eight fatal confluent cases were of the hemorrhagic type.

"To describe more in detail the origin and progress of the outbreak, the first case was recognized on the 2d of June, in the person of a child, three years old, sick with varioloid. The case occurred in the practice of Dr. Fontaine, a graduate of the Victoria Medical School, of Montreal, who has been in Spencer, about a year. The child attacked lived in the same house in which Dr. Fontaine boarded. The next case was that of a young man living a quarter of a mile away from the first, and the disease in his case was diagnosticated on the 4th of June, and proved to be confluent variola.

"The source of the contagion in these two original cases is involved in obscurity. The only explanation offered is, that in the April previous, while small-pox was prevalent in Worcester, the father of the child first attacked visited friends in that city, and was directly exposed to the contagion. An interval of, at the least, a month must have elapsed, during which, on this hypothesis, the infection was latent in clothing or other material. More-

* The population of the town in 1870, was 3,952.

over, the two Spencer cases developed almost simultaneously, and must have contracted the disease together, most likely from the same source; it does not appear, however, that the young man was intimate at the house where the child lived, or that any special opportunity offered for the infection to be conveyed coincidently, either from Worcester or from any other source.

"These two cases may be regarded as constituting the first stage of the epidemic. Both the cases were reported to the town authorities without much delay; the child, being young and quite sick, was isolated at home; the adult was removed to the hospital.

"The second series of cases dates from June 17th. Between the 4th of June, when the second case was reported, and the 17th, no new cases came to light. During the week ending June 24th, *fifty-two* (52) *children* were admitted to the small-pox hospital. Whence did the infection in these 52 cases originate? The interval was not long enough to allow the regular stage of incubation to be fulfilled, even if we, at the outset, admit that all these 52 cases were exposed, through disregard of the established quarantine, to the contagion in the persons of those originally attacked,—an admission unsupported by facts, and unreasonable with regard to a community greatly disturbed by dread of the epidemic. There is no evidence that the contagion was spread in this way; but the strong presumption is, that the disease was disseminated by the inoculation of small-pox virus. All these 52 cases entered the hospital, showing upon their arms the points at which Dr. Fontaine had inserted, within the previous fortnight, a virus which he had represented to be vaccine. It is, of course, very important to know the real character of this virus, but on this point the evidence is somewhat confused, and is almost entirely circumstantial. Dr. Fontaine's own statement is as follows:—'The occurrence of the two cases of small-pox at the first of June, created at once a demand for vaccination. The demand came when I was short of vaccine virus. I had, the month before, vaccinated a child in the house where I lived—a brother of the child which was afterwards attacked with varioloid; the crust from this arm I used when it was mature; also a crust procured by express from Mr. Jacques, a French Canadian druggist, of Worcester. The original stock of the virus used in the first case came about a year ago, from my brother, a physician in Canada, and was from the heifer. I vaccinated in all about one hundred and fifty (150) children, of whom, within 10 days after the vaccination, about 50 came down with varioloid; the cause of this sudden seizure, I do not know.'

"While in many points, this testimony of Dr. Fontaine agrees with other evidence gathered, there are certain important discrepancies. It is asserted on good authority, for example, that the child from whom Dr. Fontaine alleges that he took the crust, was really vaccinated after the brother sickened with varioloid, and not before. Moreover, the figures of Dr. Fontaine's statement are themselves somewhat at fault; the one crust from Worcester, whose reliability is fully accredited, would go only a little way toward vaccinating the 150 persons, and the deficit is not filled.

"But we may leave out of view all the conflicting statements, and all the hearsay and other doubtful evidence; we still have these facts admitted by all concerned, including Dr. Fontaine himself; namely,—

"(a.) That 52 children had virus inserted in their arms by Dr. Fontaine;

"(b.) That within 14 days after this operation, and without having been exposed to contagion, these children entered the hospital in the eruptive stage of small-pox;

"(c.) That no other persons besides these children had the disease in the same time.

"These avowed facts point strongly to the inference that, in some manner, either directly or indirectly, the disease was propagated by the virus used by Dr. Fontaine.

"Confirmatory of this presumption are the opinions of medical men who saw the cases while they were in hospital. Dr. Alfred Hitchcock, of Fitchburg (who had formerly seen the development of inoculated small-pox), writes: 'I have no hesitation in saying that, from what I saw, and learned from reliable sources, there were between 40 and 50 cases of inoculated small-pox in that town. Of the origin of the disease, there can be no question but what it was all (I mean the inoculated cases) propagated by Dr. Fontaine.'

"Dr. Joseph Sargent, of Worcester, writes thus:—'I was called to Spencer the 26th June. * * * * I inspected 49 cases of small-pox. * * * A very important question was as to the character of the disease; viz., whether it was an ordinary epidemic of small-pox, or whether it was small-pox by inoculation. I stated to the selectmen that I had never seen small-pox by inoculation, but that the disease here was very different from small-pox as I had seen it. The difference was in several particulars,—

"'1st. But few of the patients were sick enough to be confined to their beds, the most of them, even when the eruption was so abundant as almost to cover the skin, being able to move about, or, if they were children, to run about.

"'2d. The eruption was never vesicular, and, however abundant, was without induration in the sub-cutaneous cellular tissue; the patients looking as if they were covered with pearls of various sizes.

"'3d. The eruptions did not present so much of the umbilicated character as is usual in epidemic small-pox, and especially where the eruption is abundant.

"'4th. In no case was there eruption in the fauces. * * * *

"'Many of these patients presented on the arm a deep, circular ulceration, from which a disk had sloughed out, as we occasionally see in vaccination with the cow-virus, so called.

"'My impression was that this was small-pox by inoculation.

"'I do not agree with ——— in his theory of the origin, because the disease propagated was peculiar and very rare, while that kind of exposure [by ordinary infection] is very common.'

"Again, Dr. C. A. Bemis, of Spencer, who had sole charge of the small-pox hospital, states that the 50 cases alluded to seemed to him to have distinctive marks; that the symptoms were, except in two or three cases, unusually light, even for varioloid; that the eruption did not appear to invade the true skin, but was more superficial than is common; and that the mucous membrane of the mouth, pharynx and bronchi escaped attack. He states, also, that the inflammation of the arms of the children about the points where the virus was inserted was excessive in every case, terminating in a deep slough and indolent ulceration, thus confirming the observation of Dr. Sargent.

"In all these facts there appears to exist a correlation that is more than chance coincidence. The probable hypothesis is, that in order to answer the demand for the vaccination of 150 children, more or less, the supply of vaccine virus was supplemented and adulterated by virus of variola taken from the child which was isolated in the same house with Dr. Fontaine, and under his care. It is, however, only fair to Dr. Fontaine to add

here that, at the examination before the grand jury concerning the charge of manslaughter, based on the death from small-pox of one of the children alleged to have been inoculated, no witness testified to the fact that small-pox virus was taken and used, although there were plenty who felt convinced that such was the case. Dr. Fontaine denied the charge.

"The third stage of the epidemic comprises the cases which developed by contagion from those already described. Of these there were 19. They presented no peculiarities to distinguish them from the ordinary history of variola. With the recovery of these persons, the epidemic came to an end.

"A word should be added with regard to the management of the epidemic by the town authorities of Spencer. The conduct of the selectmen, in the performance of their duties as a board of health, appears to have been in all respects commendable; with a promptness and wisdom that was noteworthy, they put into action the best measures for the prevention and cure of the disease. A hospital was immediately opened in a remote part of the town, and was placed in the charge of Dr. Bemis, who effectively seconded, by his skill and energy, the efforts of the selectmen. Every case, as it was reported, was at once transferred to this isolated hospital. The houses wherein the disease showed itself were disinfected, and care was taken that infected clothing was properly disposed of. Free vaccination was offered to all the inhabitants of the town. The speedy extermination of the disease, after it had apparently gained such a foothold, attests more emphatically than words the efficiency of the measures employed. If unhappy suspicions attended the progress and propagation of this short-lived pestilence in Spencer, those suspicions were almost neutralized in effect by the decisive action of the sanitary guardians of the town.

"Very respectfully, yours,

"F. W. Draper, M. D."

Springfield.—"There has prevailed during the last autumn what might be called gastro-intestinal fever, not typhoid (though cases of typhoid have existed at the same time), but lacking the essential symptoms of true enteric fever. The prominent symptoms were nausea, loss of appetite, perhaps vomiting, accompanied with looseness of the bowels, generally marked, but for the most part with little or no pain, pulse 100, temperature 99.5°, tongue slightly furred, some headache. This condition yielded oftentimes in two or three days with perfect recovery, and perhaps in as many instances lasting six to ten days. This condition of ill-health is worthy of notice, rather from its general prevalence than from its severity. Many of these cases were doubtless called typhoid fever, and may have been due to a kindred cause, which developed some undoubted cases of enteric fever. Impure water and insufficient drainage in a large portion of the city would seem to furnish *cause* enough for a more serious outbreak of disease even than we have experienced."

Stockbridge.—"Catarrhal difficulties in the spring and fall, and diarrhœas in the summer, are usually more or less prevalent in our region, though we have had no severe disease specially prevalent.

"We have very great dampness in the spring and fall, which I think might be improved by better drainage. Attention to diet would probably modify or remove the tendencies to the disorders of the bowels. There have been a few cases of diphtheria, which I traced to poor condition of cellars, dampness about the premises, and poor living.

"Unfortunately, we have no 'health authorities'; sometimes we might be better if we had."

Stoneham.—"A few cases of typhoid fever have prevailed.

"The selectmen constitute the board of health. They are good men, but cannot attend to the duties for lack of time. We need a separate board of health very much. Nuisances abound,—such as pigstys, filthy privies, etc. They take no action without a complaint being lodged, and people are averse to do this. We need a vigilant board of health to examine the town without a complaint. Selectmen are too much afraid to give offence."

Stoughton.—"I have attended seven cases of cerebro-spinal meningitis, and neighboring physicians have probably attended as many more. No fatal cases. It is remarkable that in Easton and North Bridgewater the cases were more numerous and severe, south and south-westerly; while in Canton and Sharon, north and north-westerly, I understand there were no cases. Measles have been extremely prevalent, but mild. We have had seven or eight cases of varioloid; one case with heart disease proved fatal.

"The local health authorities are intelligent, vigilant and efficient."

Swansea.—"No form of disease has been specially prevalent in this town. The health authorities of the place are quite 'intelligent, vigilant and effective.'"

Tewksbury.—"There has been no prevailing disease during the past year in this institution (the State Almshouse), to which my practice is entirely confined. My impression is that I have heard of more cases of typhoid fever than usual in this town, and I have no doubt it has owed its origin to some *local cause*, as my experience has led me to the conclusion that typhoid fever originates in that way.

"I have never heard that any investigation has been made by the authorities in this direction, and I presume that none has been made."

Topsfield.—"No diseases have prevailed except cerebro-spinal meningitis, of which there were seven or eight cases in the spring and summer. The cause was probably bad air and exposure to sudden changes of temperature. Most of the subjects worked in shoe manufactories. The causes of the disease would in some degree be removed by better ventilation.

"The selectmen act as a board of health. I do not know that they have taken cognizance of any matter in their capacity as a board of health. I think they have not."

Upton.—"No diseases have been specially prevalent. Enteric diseases, with typhoid symptoms, have been most prominent. Acute bronchial and lung diseases next. Want of care in regard to necessary exposure and habits of living account for much. But why these should be followed by respiratory, enteric, rheumatic or other diseases, I cannot fully explain. My experience here leads to the belief that the cause of much of the sickness lies with the individual, and might be avoided by forethought and care. For example: a person has worn flannel underclothing through the winter and escaped sickness beyond an occasional cold. As spring comes, the first appearance of relenting weather makes the flannel burdensome at times, and on the first mild day the underclothing is laid aside. Now the capillaries, which have

been accustomed to protection for three or four months, feel the change, but cannot so suddenly adapt themselves to the circumstances, and the effect is a chilling of the blood, which results, probably, in lung fever.

"Another example occurs in the summer season. During a hot day in July, a person drinks a large quantity of water, sometimes with ice in it, and drinks often. At this time, the work is driving and he feels the necessity of eating in proportion to the work. Under these circumstances, the stomach cannot properly digest the food, and dispose of the large quantity of water. The result is a colic, or cholera morbus or a diarrhœa; and if the standard of health has been anything less than usual with the person for a few weeks, the chances are that typhoid symptoms will follow, but the latter, I think, come later in the season.

"The local health authorities are intelligent, vigilant and efficient."

Walpole.—"There was a severe epidemic of influenza during the late spring months. No cause for it was discovered.

"The local health authorities are intelligent, negligent and inefficient."

Ware.—"Typhoid fever has been unusually prevalent. I know of nothing existing this year to cause it more than every year. It has been in all parts of the town, and no local cause could be discovered. I have no doubt that more perfect cleanliness about dwellings and out-houses would do something to prevent it, but it has occurred in many cases where no such cause could be assigned.

"The local health authorities are intelligent, vigilant and efficient."

Warren.—"No diseases have specially prevailed, except, during the past winter and spring, a form of influenza called by the people 'the horse disease.' No cause for it could be discovered.

"We have no health authorities aside from the selectmen. They have been ready to receive advice from medical men, and act upon it."

Warwick.—"We have had the past fall quite an epidemic of typhoid fever, but not fatal. The poison of typhoid fever is specific, and seldom attacks an individual more than once. Filth and moisture are predisposing and aggravating causes. There is a place just over the line in New Hampshire, which is a special nidus of typhoid fever. It is on the eastern declivity of a hill which is full of springs, and the soil is cold and damp. The privy near the kitchen causes frequently foul exhalations. Six years ago, most of the members of a large family were attacked with a severe form of fever, and two died. A year after, another member of the family, who escaped the first attack, had it; and a young lady who was living in the family contracted the fever, went home, and gave it to her mother. A young lady, who belongs to a family that is not subject to fever, worked at this place last summer, contracted the poison, went home, and had a severe attack, with an eruption of rose spots and sudamina. There was no case of it in the family.

"A number of years ago, there were two fatal cases at a hotel where there were foul effluvia arising from the sink-water. I have no doubt many cases might be avoided by cleanliness and proper drainage.

"In small towns we have no local health authorities."

Webster.—"The public health of this town has been usually good during the past year. There has been no epidemic disease, except, perhaps, a mild

form of bilious remittent fever. Typhoid, so generally prevalent here, has hardly been met with. I think I can report the public health of Webster better than for any year during the last decade.

"I am happy to say Webster has a very intelligent and efficient board of health officers. I would suggest, however, that an independent board of health in towns (I mean independent of the selectmen), elected in the same manner that school committees are now elected, would prove far more useful. This plan would secure a majority of the board in office long enough to mature and carry out such plans as they deemed best for the public good. As it is now, they are liable to be changed each year."

West Brookfield.—" Typhoid fever has been especially prevalent this autumn (1873), and has not yet ceased. My attendance upon typhoid patients commenced in June, and has continued to December. I know of nothing in the clinical history of these cases, twelve in number, to indicate their causation. In all of the cases the abdominal symptoms were especially marked in character. In one case a relapse occurred after convalescence was established, from the young man's eating a raw apple which he purloined in his mother's absence. Abdominal symptoms followed, and a rupture of the bowels terminated the case in ten days from the relapse. No *post mortem* was allowed.

"I believe that typhoid fever is preventable to a large extent. How? By keeping one's physical powers fully up to the normal standard; and in all respects maintaining, as near as can be approximated, perfect hygiene. In each one of these cases there was some peculiar influence operating upon the individual. In one family, living in a damp basement where the street drainage found its way into the dwelling, was certainly the cause of disease.

"In two cases, young women who worked in cotton factories, and who had been in a condition of amenorrhœa for months, giving a history of chlorosis, were subjects of disease. A third case was a woman, who was not as yet fully out of the puerperal state.

"In so far as boards of health and their action are concerned, I suppose we stand in the same mess as most country towns."

West Newbury.—" We have had very little sickness out of the usual course. The most prevalent disease has been a very mild epidemic of measles, from which there were no fatal cases so far as I have been able to learn. There were two cases of cerebro-spinal meningitis, one fatal. Also a very few cases of scarlet fever, confined to two families. I am convinced that the above disease may be prevented from spreading by proper care and precautions.

"As to the fourth question, I suppose we say with many other towns that our board of health is composed of men of intelligence, but as to vigilance and efficiency, perhaps the less said the better."

West Springfield.—" We, in common with the rest of the State, suffered from small-pox, originating in the rag-picking room of one of our paper mills, and spreading rapidly, from there being no care taken to isolate the sufferers. Later, there were a very great number of cases of measles among the school children, in some instances almost closing the schools. It would seem to me that we could have better control of these children's contagious diseases if, during the prevalence of an epidemic, the children could be assembled simply for recitations, without sitting in the crowded school-rooms all day, exposed to the contagion of the already infected, while studying.

"At present, we are having a rather unusual number of cases of typhoid

fever. One cause for this, I think, is that certain parts of our town have grown very rapidly in the last few years. A great many tenement houses have been put up near together. The drinking-water is generally obtained from tubular-driven wells, generally from eighteen to twenty-five feet deep. We have no sewerage, and the out-houses are generally simple sheds over open trenches a very little distance from the houses. The soil is generally sandy, and it would seem as if everything favored the contamination of the drinking-water. Some practical system of sewerage, and the bringing of water from a distance would, I think, have a favorable effect on our autumnal fevers.

"The answer to your last question I hardly know how to give. We really have no health authorities. I suppose, however, the selectmen have the authority to introduce any sanitary measures they may think needed. But I do not think they pay much attention to this part of their duty."

Weymouth.—"During the summer months dysentery prevailed to a considerable extent, but was quite mild in its type. I have seen no fatal cases among a large number affected.

"During the autumn, typhoid fever has been unusually prevalent; also mild in its character.

"There have probably been more than fifty (50) cases of typhoid fever within a circle of the radius of one mile. I am not aware of any influence, except atmospheric, operating alike on all, or a large majority of the persons affected. It has come to the poor, and to those in comfortable circumstances the same; to those occupying high, dry and airy locations, and to those living in damp, ill-ventilated houses; filth has neither appeared to invite or repel it; sex, employment or milk-supply, have not seemed to make any difference with it, but cases have frequently appeared seeming to arise from infection. About one fatal case in twelve. Some cases of dysentery seemed to originate from imperfect drainage.

"I think the patients with typhoid should be isolated from those of susceptible age. I am at present *sure* of nothing more, though I should use the ordinary precautions of cleanliness.

"I do not know that we have any special health authorities other than the selectmen, who have a general supervision of the interests of the town."

Williamstown.—"Upon the grounds of the Williamstown Manufacturing Company, fever of the typhoid type has been 'especially prevalent.' It was my fortune to attend upon but one case, which recovered.

"I saw another, but the patient was moved in a day or two to another part of the ground, and I lost sight of her; she died. I do not know how many *bona fide* cases there were, but there were many, I have heard as high as 60; a number very sick. And the cases were in almost the same locality as described in my previous letter, three years ago.

"We have also had sporadic cases of meningitis. I have not 'discovered' the 'cause.' I once attributed it to the water, and my conviction now is that to that source, combined with local causes as previously set forth, is to be ascribed the disease.

"Such causes are preventable, but the blindness of corporations greedy of gain, cannot see the causes, and turns a deaf ear to all representations respecting the source of disease, or even are angry if you hint at danger and point to the remedy.

"Our local health officers are the selectmen. Neither in Williamstown nor

Adams, in my humble opinion, is there the slightest regard paid to the health of the towns. Nothing short of a Shreveport calamity will so emphasize the necessity of health boards in this section that they will be appointed."

Worcester.—"During first six months of the year, small-pox prevailed—125 cases. Nothing else.

"The board of health here is the mayor and board of aldermen. Most of them are intelligent, but are not vigilant or efficient in regard to health matters. Much might be done to remove the causes of disease, by removal of filth, improvement in the tenement houses, etc., having the whole under the care of a separate board of health from the aldermen. The city physician is health officer in name, but he has no authority or voice in anything whatever. Our death-rate is high and ought to be greatly diminished. We ought to be a very healthy city."